FISCAL POLICY IN PRIMARY COMMODITIES EXPORTER LDC's
AN EMPIRICAL INVESTIGATION OF THE FRANC ZONE IN AFRICA

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ABSTRACT

The research aims at analyzing various fiscal policy issues faced by primary commodities exporter developing countries with a special emphasis on the Franc Zone countries in Africa. This research sets for itself three objectives.

The first objective is to understand how the environment in which fiscal policy decisions must be made influences the way fiscal policy responds to fluctuations in the price of the main export commodity. The second objective is to understand, in the specific case of the Franc Zone countries, the relationship between fiscal policy as the instrument of adjustment and the real exchange rate as a measure of the extent of adjustment. The third objective is to evaluate under what conditions a fixed exchange rate regime with fiscal policy as a policy instrument for adjustment and growth is preferred to a flexible exchange rate regime with nominal devaluation as the policy instrument.

Using data from the Franc Zone countries, we are able to show evidence of the existence of policy reversal costs and of liquidity constraints which are likely to play a role in explaining the typical surge in fiscal expenditures which accompanies a commodity boom and the tendency to maintain that level of expenditures in spite of the subsequent decline in export commodity prices.

Using data from Côte d'Ivoire, we are able to show that the behavior of fiscal policy is almost exclusively determined by changes in the prices of the main export commodities (coffee and cocoa). The model proposed replicates quite well the inflation cycle (hence the behavior of the real exchange rate) experienced by Côte d'Ivoire.

Solving a model of output and price determination under different shocks and under different adjustment strategies (fiscal versus exchange rate policy), we argue that for most countries in the CFA Zone, the cost of membership in one of the monetary unions must have been quite high and that the relatively more industrialized countries and those whose export sector is less diversified benefit less from the institutional arrangements of the Franc Zone.

Thesis Supervisor: Professor Stanley Fischer (and Professor Shantayanan Devarajan)
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CHAPTER 1

INTRODUCTION AND STATEMENT OF OBJECTIVES

1.1 Purpose and Motivation of the Thesis

The research aims at analyzing various fiscal policy issues faced by primary commodities exporter developing countries with a special emphasis on the Franc Zone countries in Africa.

Many developing countries rely heavily on one or two primary commodities for foreign exchange earnings. For example, more than 70 developing countries derive at least 50 percent of their export earnings from non-fuel primary commodities. For Sub-Saharan Africa, primary commodities exports are even more important: in 1985, they accounted for 94 percent of total merchandise exports\(^1\).

For most of these countries, fluctuations in the international price of the main export commodity have important implications for the government revenues since the government is likely to either own the production facilities (e.g., Nigeria for oil) or have set up a commodity price stabilization fund\(^2\) (e.g., Côte d'Ivoire for

\(^1\)The corresponding figures for developing countries as a whole and for industrial economies are respectively 60 and 20 percent.

\(^2\)A discussion of policy choices for price stabilization of primary commodities can be found in Bosworth and Lawrence (1982).
coffee). Furthermore, trade taxes are often a large portion of government revenues.

The sharp fluctuations in primary commodities prices (booming markets in the 1970's followed by low real prices in the mid 1980's) translate into similar fluctuations for the main source of government revenues. The thesis discusses the conduct of fiscal policy in commodity-exporting countries faced with fluctuations in the international price(s) of their main export commodity(ies).

What follows motivates each of the issues addressed by the thesis.

Typically, following a commodity boom, primary commodities exporter developing countries have experienced a surge in government expenditures which continued in spite of the subsequent decline in the price of primary commodities. Thus, it is suggested to analyze the environment in which fiscal policy decisions must be made in order to understand the behavioral response of the fiscal authorities to fluctuations in the export commodity prices.

The Franc Zone countries in Africa constitute an ideal set of countries to study fiscal policy in primary commodities exporting countries. The zone is the largest and most enduring currency block. Thirteen countries, all relying heavily on primary commodities, are engaged in a monetary union which involves pooling
foreign reserves, a common currency whose convertibility is guaranteed by France, and a fixed exchange rate with the French Franc. By abdicating the right to devalue and by adopting rigid monetary rules, the member countries (which can nevertheless borrow abroad) only have one instrument left: fiscal policy. A money supply which is essentially exogenous and a currency pegged to the French Franc enhances the importance of fiscal policy as the instrument of adjustment and growth.

Despite being in a monetary union with a common currency and pooled foreign reserves, the Franc Zone countries have had substantially different inflation rates. Thus, it is suggested to analyze whether behavioral differences in fiscal policy responses to fluctuations in the price of the main export commodity can explain these inflation differentials.

Most of the Franc Zone countries in Africa have experienced nearly a decade of falling per capita GDP. The principles of the Franc Zone and the influences of the institutional arrangements on the economic performance of the member countries is often the subject of political debates. In particular, the lack of nominal depreciation as an adjustment tool is often criticized. Earlier, membership in the zone was viewed as beneficial since it was expected that guaranteed convertibility of the CFA Franc and fixed exchange rate would lead to a stable environment which would stimulate foreign investment and growth. However, in the later
part of the decade, the CFA countries relied on expenditure reduction and in particular investment reduction to improve their current accounts while neighboring countries, through currency depreciation, relied on expenditure switching. Although a lot of these countries went into decline as well, none of the recent successful adjustment programs\(^3\) have taken place in the Franc Zone. Thus, it is suggested to compare fiscal policy and exchange rate policy as adjustment mechanisms in order to analyze under what conditions one adjustment strategy may be preferred over the other.

1.2 Scope of Thesis

This research sets for itself three objectives. Three essays, each addressing one of the objective, constitute the core of the thesis.

The first objective is to understand how the environment in which fiscal policy decisions must be made affects the government's response to fluctuations in the international price of its main export commodity.

The second objective is to understand, in the specific case of the Franc Zone countries, the relationship between fiscal policy, the instrument of adjustment, and the real exchange rate, a key variable which measures the extent of adjustment.

\(^3\)For example, Ghana, Mauritius and Tanzania. See, World Bank (1989).
The third objective is to compare two adjustment strategies, fiscal policy and exchange rate policy, in order to understand under what conditions one balance of payment adjustment mechanism over the other.

1.3 Outline of Thesis

Chapter 2 serves as a background chapter. It describes the institutional arrangements of the Franc Zone in Africa and explains their origin in an historical context.

Chapter 3 suggests that the typical surge in fiscal expenditures which accompanies a commodity boom and the tendency to maintain that level of expenditures in spite of a subsequent decline in export commodity prices may be explained by the existence of a pressure to spend, a limited disinvestment or policy reversal and a limited indebtedness effects. These three effects characterize the environment in which fiscal policy decisions must be made. The chapter uses a fiscal policy optimizing model to look for evidence of the existence of the three effects mentioned above and uses the unconstrained and constrained Euler equations of the model to estimate Lagrange multipliers associated with the limited indebtedness constraint. The estimation results suggest that the pressure to spend effect may not play an important role but that policy reversal costs and liquidity constraints are likely to play a role in explaining the behavior of fiscal policy in the Franc
Zone countries in Africa.

Chapter 4 develops a model of the determinants of inflation among Franc Zone countries in Africa. As stated earlier, the Franc Zone countries experienced substantially different inflation rates, especially in the short run. The model of inflation differentials developed in the chapter is based on behavioral differences in the response of fiscal policy to fluctuations in the price of the main export commodity. The model tracks quite well the inflationary cycle experienced by Côte d'Ivoire following the coffee price boom of 1975-76. It is shown that changes in the export commodity prices have important effects on the domestic price level and therefore on the real exchange rate.

Chapter 5 aims at evaluating whether the institutional arrangements of the Franc Zone in Africa which emphasize fiscal and monetary discipline can sometimes lead to inadequate adjustment strategies. A model of output and price response to various shocks is used to evaluate how the nature and the magnitude of external shocks influence the optimality of one current account adjustment rule (with fiscal policy as the instrument used to reach balance of payments equilibrium) rule over the other (nominal exchange rate as the instrument used to reach balance of payments equilibrium). It is shown that the relatively more industrialized countries and/or the countries whose export revenues come mostly from a single primary commodity are less likely to benefit from the institutional
arrangements of the zone. Time series for a country specific parameter interpreted as a measure of the cost of staying in the union are derived and used to show that the costs of staying in the union must have been quite high for most countries.

Chapter 6 concludes the thesis by summarizing its contributions.
CHAPTER 2

THE FRANC ZONE IN AFRICA¹

2.1 Introduction

Chapter 2 serves as a background chapter. It describes the institutional arrangements of the Franc Zone in Africa and explains their origin in an historical context.

The Franc (or CFA) Zone in Africa is a very unique monetary institution. It consists of two monetary unions: the West African Monetary Union for which the central bank is the BCEAO (Banque Centrale des Etats de l'Afrique de l'Ouest) and the Central African Monetary Union for which the central bank is the BEAC (Banque des Etats de l'Afrique Centrale) and of the Comoros islands which have their own central bank.

There are seven countries in the West African Monetary Union: Benin, Burkina Faso, Côte d'Ivoire, Mali, Niger, Senegal and Togo. There are five countries in the Central African Monetary Union: Cameroon, Central African Republic, Chad, Congo, Equatorial Guinea and Gabon.

¹I gratefully acknowledge helpful discussions with staff members of the World Bank and of the International Monetary Fund particularly P. Berlin (IBRD), R. Westerbee (IBRD) and P. Dhont (IMF).
As can be seen from Table 2.1, the Franc Zone in Africa regroups countries with very different economic situations. In each monetary union, these countries have a freely circulating common currency, the CFA Franc, which is pegged to the French Franc at the rate of CFA = 0.02FF. This rate has not changed since 1948. France which manages (through operation accounts at the Treasury) the foreign exchange reserves of the countries above, guarantees the unlimited convertibility of the CFA Franc into French Francs.

As seen in Table 2.2, most of the Franc Zone countries in Africa have now experienced nearly a decade of falling per capita GDP. Although a lot of other Sub-Saharan African economies went into a decline as well, none of the recent successful adjustment programs\textsuperscript{2}, (e.g., Ghana, Mauritius and Tanzania) have taken place in the Franc Zone. Furthermore, as is now often documented in the press\textsuperscript{3}, from Dakar to Libreville, banking crises and political instability are becoming the norm.

The principles of the Franc Zone in Africa and the influences of the institutional arrangements of the monetary unions on the economic performance of each of the member countries is often the subject of political debates. The greater monetary discipline imposed by the union and the existence of a convertible currency are generally viewed as beneficial. However, the lack of nominal depreciation as an adjustment tool and the reduced autonomy in

\textsuperscript{2}See, World Bank (1989)

\textsuperscript{3}For example, in Le Point (6/90), the Economist (3/90), Jeune Afrique Economie (6/88) and Marches Tropicaux (12/89).
setting country specific monetary policies are criticized.

2.2 The Functioning of the Franc Zone

The Franc Zone is based on a series of agreements between the member countries and France. In terms of these agreements, France guarantees the unlimited convertibility in French Francs of the CFA Francs issued by the central banks. In counterpart, for each monetary union, the African countries commit themselves to

- allow substantial capital mobility;
- peg the CFA Franc to the French Franc;
- follow France's legislation on foreign exchange controls;
- pool their foreign exchange reserves by placing them in a special account at the French Treasury; and
- allow France to participate directly in the monetary policy adopted by each of the central bank.

The guarantee provided by France is the essential characteristic of the Franc Zone. Through its unlimited convertibility into French Francs, the CFA Franc is in fact a fully convertible currency. This guarantee can only be provided if in exchange the countries commit themselves to a monetary policy that prevent each union to have an arbitrarily high deficit in its operation account at the French Treasury. Therefore, the free convertibility of the CFA Franc cannot be dissociated from restrictions imposed by France on the conduct of monetary policy.
As a result, the central banks must implement a monetary policy which essentially guarantees that each union will not run into a foreign exchange crisis. This concern for avoiding substantial deficits in the central banks' operations account at the French Treasury is reflected in the banks' statutes which require that each bank introduces corrective measures when the ratio of its foreign assets to its liabilities falls below a certain threshold.

Note that the decision to restrict credit is based on the level of foreign reserves for the monetary union as a whole while the restrictions themselves penalize more heavily countries which are the source of the deficit. However, countries that run a small surplus in their current account may be forced to restrict credit (thus limiting investment possibilities) as a result of poor foreign reserves management of deficit countries. Therefore, in setting monetary policy, the central banks have as their primary objective a balance of payments result. In practice, a country who contributes to the decline of the overall balance of payments of the zone is targeted for credit restrictions. This monetary contraction, as emphasized in the literature on macroeconomic adjustment in fixed exchange rate regimes, is part of an automatic adjustment mechanism. See, for example, Tower and Willet (1976)

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4 More precisely, the BCEAO or the BEAC are required to decrease their rediscount ceilings when the ratio of their average foreign assets to their average liabilities have fallen to a level less than 20 percent for 30 consecutive days. The rediscount ceilings must be reduced by 20 percent in countries for which the foreign reserves account at the French Treasury is in deficit and by 10 percent in countries for which the foreign reserve surplus is less than 15 percent of the monetary circulation.

Furthermore, there are strict limits on central bank financing of the budget deficit. The central banks are not allowed to provide credit to member governments in excess of twenty percent of their fiscal receipts from the previous year. This essentially establishes a need for a balanced budget. However central banks cannot deny credit to a government which has not yet borrowed what it is legally entitled to and this regardless of other credit limitations that may be imposed economywide.

More detailed descriptions of the institutional arrangements of the Franc Zone can be found in Vinay (1988) and in Vizy (1989).

2.3 The Nature of the Guarantee Provided by the French Treasury

The pooling of the foreign reserves plays the role of risk sharing by providing an insurance scheme to each individual country and limits the possibility of a foreign exchange crisis for the central banks. In fact, until 1987 for the BEAC and until 1980 for the BCEAO, the level of foreign reserves at the French Treasury was positive so that the guarantee itself did not come into play. This guarantee, simply because its existence, may provide enough incentives for domestic residents to keep their foreign exchange in their home country (i.e. absence of capital flight) and for

\[\text{However, the guarantee prevents them from ever having their imports disrupted as has been the case in countries such as Ghana, Mozambique and Nigeria where domestic production (which is highly dependent on imports) was strangulated.}\]
foreigners to invest more than what they otherwise would since they are completely (at least if they are French) insured against currency variability.

In order to understand the nature of the convertibility guarantee provided by France to the African countries of the Franc Zone, it is helpful to have a measure of the importance of each country in terms of its money supply. In 1987, the total money supply (M2), expressed in French Francs, was of 24,046 millions for the BEAC and of 38,865 millions for the BCEAO. France's money supply, for that same year, was 2,718 billions. Thus, the total money supply of the two zones was only 2.31% of the French money supply. This figure, by being so small, makes the convertibility guarantee very credible.

The French guarantee has been criticized on the ground that the BCEAO and the BEAC were prevented from accessing foreign capital markets to manage their foreign reserves portfolio. In

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6 In each zone, a single country holds about 1/2 of the money supply: For Côte d'Ivoire and for Cameroon (1987), the figures are respectively 49.2 percent of the BCEAO's and 56.4 percent of the BEAC's money supply.

7 The incidence on the French economy of the existence of the African part of the Franc Zone is very small. (The total GNP of the Franc Zone countries (including the Comoros) is only 5% of the French GNP and, although a substantial share of the trade of the Franc Zone countries in Africa is oriented toward France, these countries represent only 2.04% of French imports and only 2.7% of French exports.) The 2.31% ratio is too small for the monetary emissions of the two central banks to have a significant influence on the French money supply. The level of foreign transactions of the two central banks is also too small to have a significant influence on the foreign exchange market in Paris (and thus on the value of the French currency). It is true that there must be times when France gains. For example, if the two Central Banks have foreign reserves surpluses and if the interest rate offered on the French Treasury account at the time is less than the interest rate offered on outside capital markets, France then receives an implicit loan from these institutions. But there are also times when the guarantee provided by France is a cost.
1969, following the devaluation of the French franc, the central banks saw the real value of all their foreign reserves eroded overnight. Now, the central banks are allowed to place up to 35% of their foreign reserves outside France and a compensation scheme has been put in effect to guarantee the non variability of the value of the foreign reserves expressed in SDRs. Thus the critique above is no longer valid as central banks are now partially insured against fluctuations of the French Franc.

2.4 Comparison of Monetary Developments across African Nations

Most countries in Central and Western Africa are experiencing a serious financial crisis. Public agencies and private banks in the region have high levels of poorly performing loans and in some countries, in particular Benin, the financial system has nearly collapsed while in others, such as Senegal or Cameroon, a majority of the commercial banks are essentially failing.

Furthermore, the central banking mechanisms are outdated in the sense that the main instruments of monetary control are rediscounting and sectoral credit allocation. (See, Bhatia, 1985, for a description of the monetary mechanisms of the BCEAO.) Monetary reform and financial deepening would not necessarily solve the economic problems of the CFA countries but the present failures of the financial sector of the CFA countries and their economic

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8Full insurance would require a country specific compensation scheme that would cancel the effects of the variability of the French Franc on the real exchange rates.
performance suggest that it may help.

However, such innovations often face inertia from existing institutions and some understanding of the historical context of the institutions is warranted.

Exploration and colonization of Africa was followed by the development of a monetary system. The colonial powers introduced local currencies, whose emission was often carried out by private institutions. (For example, the East African Currency Board set up by the British for Kenya, Uganda and Tanzania and the Banque du Senegal—later the Banque de l'Afrique Occidentale—set up by the French for West Africa). Upon political independence, most African countries set up a central bank and a national currency. The creation of the African central banks is described, country by country, in Bortolani (1975). However, the organization of their monetary system was deeply influenced by their colonial past. The sections that follow contrast the French and the British experience.

Former French Colonies

While France was extending its domination in several parts of the world from Indochina to the Pacific Ocean and to Africa, it decided that for most of its colonies, the French Franc would be the legal currency. Until the middle of the 19th century, the French colonies did not have fiduciary money. For example, the mean of exchange in the French parts of Canada were reindeer skins
while the Caribbean used tobacco or cotton. As a result foreign monies, such as the Spanish Piastre in the Caribbean, were used. Progressively France started a monetary union with its colonies by introducing its legal currency there. At first the fiduciary money was imported from France. Then France had local institutions, under control of the French central bank, issue the currency. The Banque du Senegal, created in December 1853, became responsible for the emission of money for all of French Africa. The reason for local institutions to replace the French central bank for monetary emission was for the distribution of credit to be better adapted to each of the local economies. The crisis of 1929 and the Second World War reinforced the Franc Zone. As Western Economies became more protectionist, France aimed at reinforcing its economic ties with its colonies by defining a geographical zone in which monies were fully convertible and in which the trade policies were identical. This geographical zone was to be officially designated as the Franc Zone.

In March 1950, the Institut d'Émission pour l'Afrique Occidentale Française et le Togo was created while the Institut d'Émission pour l'Afrique Equatoriale Française started operating in January 1955. A lot of newly independent countries (e.g. Vietnam, Guinea, Algeria) chose to leave the Franc Zone. However the zone itself was strengthened by the creation of the BCEAO and of the BEAC in 1959. A detailed account of the monetary history of former Western African French colonies can be found in Julienne (1988). Mali is a particular case. It withdrew from the union in 1961. Following a serious foreign exchange crisis in 1967, it
expressed its interest in reintegrating the Franc Zone which it officially did in 1984. 1973 saw Mauritania and Madagascar leave the French Zone. Finally Equatorial Guinea, not a former colony of France, integrated the Central African Monetary Union in 1984. New reforms, giving more autonomy (with respect to France) to the member countries and aiming at defining monetary policies more consistent with the development needs of each of the member nations, were introduced in 1972 and in 1973. (See, Bhatia, 1985.)

Thus the Franc Zone has, in the course of history, shrunk, transformed itself and grown.

As has already been seen, this system demand adherence to a relatively strong set of rules in line with the style of French administration. Thus, France succeeded in creating in its territories a highly centralized and rigid monetary system.

*Former British Colonies*

The British influence on the monetary institutions resulted in a more decentralized system. Upon independence, central banks were set up in all the former Sub-Saharan African British colonies, all of which, at independence, were in the Sterling Area.

The Sterling Area has its origins in the first half of the nineteenth century when Britain started to dominate world trade. During its expansion, it established an automatic link between the local currencies which it controlled and the sterling.
Furthermore, the financial system of the British Empire was in the hand of British banks which naturally spread the use of the sterling. In 1931, as Britain left the gold standard, most members of the Sterling Area (from colonies to dependencies and independent states) decided to maintain a fixed parity with the sterling, keep their balances in sterling and adopt a uniform policy of exchange control.

The African colonies were subject to one of three currency boards. The role of these currency boards was to guarantee the exchange between sterling and local currencies. As in the Franc Zone at the time, the quantity of money in circulation was based on the amount of foreign reserves and not on the local credit needs. Upon independence, Britain withdrew almost entirely as far as administration of monetary institutions is concerned. The countries did not remain (except for the short lived schilling area of Kenya, Uganda and former Tanganyika) in a monetary union. A description of the banking systems of Ghana, Nigeria and former British colonies of East Africa can be found in Furness (1975).

This brief survey of African monetary history shows that the degree to which the African countries have pursued monetary independence is related to their colonial history. The colonial powers have modelled the nature of the monetary institutions of their former colonies.

As has been seen, all the former Sub-Saharan African British colonies set up independent central banks whereas all the former
Sub-Saharan African French colonies, with the exception of Guinea and Mali, chose not to change their monetary institutions. The former British colonies achieved monetary independence and acquired greater monetary experience whereas the former French colonies sacrificed the experience they could have obtained by being totally in charge of their monetary institutions for a greater monetary discipline which was imposed on them.

This is similar to the conclusion reached by Mundell (1972) who argues that the difference in cultural patterns between France and Britain reflect themselves in the currency and banking systems inherited by the African countries. Summing up his analysis, Mundell (1972) writes:

"The monetary orthodoxy of Paris and the Keynesian heterodoxy of London have affected the monetary philosophies of the former colonies." "The French have stressed the passive nature of monetary policy and the importance of exchange stability with convertibility (within the franc area); stability has been achieved at the expense of institutional development and monetary experience. The British countries by opting for monetary independence have sacrificed stability, but gained experience and better developed monetary institutions."

2.5 Analysis of the Current Situation

For the last 10 years, most of the countries of the Franc Zone in Africa have experienced slow or negative growth in GDP per
capita, loss of competitiveness, large buildups in external debt and a near collapse of their financial systems.

A number of factors influence the ability of the central banks to conduct monetary policy. The countries in the unions are very open as capital flows between the Franc Zone and France are essentially unrestricted. This openness limits the possibility of monetary control since interest rate and exchange rate policies are excluded.

In what follows, it is suggested that there are gaps in the statutes of the central banks that limit the effectiveness of monetary controls and that these gaps contribute to the current crisis experienced by the Franc Zone countries.

In the presence of an adverse external shock that reduces the central bank foreign reserves, the total credit to the economy is expected to be reduced. However, once the government has reached its statutory limit on central bank financing of its deficit, it can induce the public enterprises - by reducing its participation in them-to borrow from the commercial banks. Often, the government will provide a loan guarantee which may result in a less stringent assessment of the creditworthiness of the public enterprise by the commercial bank providing the loan, thus, weakening the position of that bank and eventually, if a sufficient number of domestic banks follow the same course of action, setting a financial crisis.

Another gap in the functioning of the system comes from the
fact that borrowing outside of the French Treasury by the private sector or by the government does not modify the position of the operations account that the central bank maintains in France and thus, does not affect credit allocation. This is conducive to delayed adjustment and an explosive debt situation.

The presence of these two gaps is easily understood given the history of the institutions. During colonial times, these two gaps were irrelevant since the only source of foreign financing was the mother country's transfers to the sole monetary institution in existence (Institut d'Emission) -this is what corresponds now to the compte d'operations- and since no local enterprise had access to credit.

In the case of Côte d'Ivoire, these two gaps in the system have contributed in making the country one of the world's most indebted countries (in per capita terms) and in having its financial system in serious crisis as several commercial banks are not very sound\(^9\). The crisis of the banking system has, in fact,

---

\(^9\)After its independence in 1960, Côte d'Ivoire maintained a high rate of growth for twenty years. In the late seventies, there was a boom in coffee and cocoa prices. This price increase lead to additional resources and to a surge in investment expenditures which continued in spite of a deterioration in the prices of coffee and cocoa. The policy of maintaining investment growth when domestic savings were inadequate was facilitated by the relative ease for Côte d'Ivoire of borrowing abroad. The total external debt (disbursed and outstanding) went from 20% of GNP in 1970 to 124% of GNP in 1987. For that same year, the debt service represented 15.6% of GNP and 40.8% of exports of goods and services. Once foreigners became increasingly reluctant to lend to the private sector, this lack of fiscal discipline led to the weakening of the commercial banks as several unsound loans were made to parastatal agencies.
not been limited to the Côte d'Ivoire.\footnote{In all the countries, and especially in Benin, Senegal and Mali, the commercial banks and other financial institutions have come under increasing pressure. Most banks, especially the government controlled, are insolvent. The weaknesses of the deficient banks may be responsible for the poor economic performance of the countries for which the banking system has literally collapsed. The restoration of the solvency of the failing banks will hurt countries, such as Togo, in which the banking system remained healthy since their share of dividends from the common central bank (seigniorage gains) will be reduced.}

\subsection*{2.6 Conclusions}

The analysis in the previous section shows that the monetary arrangements of the Franc Zone in Africa have structural deficiencies (whose existence can be understood in light of the historical background of the zone) which probably contributed to the widespread banking crisis and to the unsustainable level of external borrowing.

The succession of external shocks faced by the CFA countries has placed the banking systems under severe pressure and, as a result, has exposed the structural weaknesses of the monetary institutions. Once foreign borrowing ceased to be a viable alternative, the governments, unable (given the fixed convertibility at fixed parity) to resort to inflationary finance of their deficits, have exploited loopholes in the system to cover their expenditures by indirectly obtaining credit from the commercial banks.

Furthermore, although the openness of the Franc Zone may imply that the zone wide money supply is exogenous, the allocation...
of credit among the member countries is largely under the control of the common central bank. This distribution has not been determined by market principles but has been determined administratively\textsuperscript{11}.

These emerging problems suggest that a financial reform may be necessary\textsuperscript{12}. This may be hampered by the lack of monetary experience in the Franc Zone. The two gaps in the functioning of the monetary institutions of the Franc Zone must naturally be eliminated. This suggests first, that government guarantees to public enterprises (which can borrow from the commercial banks) should be included in central bank credit ceilings to the government and second, that all net foreign assets (as opposed to only central bank's net foreign assets) be taken into account when determining credit distribution among member countries. The losses of the failing banks, whose majority are government owned, will have to be absorbed by the economy\textsuperscript{13}.

\textsuperscript{11}As pointed out by Honohan (1990a), the three countries with the largest bank insolvencies (Benin, Côte d'Ivoire and Senegal) are also the countries which have received the lion's share of central bank credit. The inter-country allocation of credit has been driven to finance what has proved to be unsound lending by the banks in the most influential countries. Not surprisingly, these three countries are also the ones with the largest external deficits. This situation implies that poor countries such as Burkina Faso, Mali and Togo are implicitly bailing out the richer ones.

\textsuperscript{12}An increasing number of developing countries, such as Indonesia, Kenya, Philippines and Thailand, have initiated monetary and financial reforms. (See, for example, Johnston and Per Brekk, 1989 for a review of the recent experiences in developing countries.) These countries have usually began to move toward open market operations while relaxing administrative controls which tended to distort the allocation of resources. Typically, the system of monetary controls in these countries involved control and preferential allocation of credit by sectors and controlled interest rates.

\textsuperscript{13}This is likely to put severe pressure on already strained government's budgets unless the government is able to issue government bonds. Interestingly, the Napoleonic Wars for Britain and the Civil War for the United States were catalysts in stimulating financial development. After the wars, the existence of a sizable public debt provided local banks with a security against which they could issue loans. In contrast, the lack of a debt holding class in Germany maintained financial repression in nineteenth century Prussia.
<table>
<thead>
<tr>
<th></th>
<th>AREA (th. sq. km)</th>
<th>POPULATION (1,000 hab)</th>
<th>GNP (bill $)</th>
<th>GNP/CAP ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benin</td>
<td>116</td>
<td>3,809</td>
<td>1,110</td>
<td>290</td>
</tr>
<tr>
<td>Burkina</td>
<td>274</td>
<td>6,666</td>
<td>1,210</td>
<td>180</td>
</tr>
<tr>
<td>Iv. Coast</td>
<td>322</td>
<td>9,294</td>
<td>6,730</td>
<td>720</td>
</tr>
<tr>
<td>Mali</td>
<td>1,240</td>
<td>7,277</td>
<td>1,110</td>
<td>150</td>
</tr>
<tr>
<td>Niger</td>
<td>1,267</td>
<td>6,057</td>
<td>1,460</td>
<td>240</td>
</tr>
<tr>
<td>Senegal</td>
<td>197</td>
<td>6,195</td>
<td>2,730</td>
<td>440</td>
</tr>
<tr>
<td>Togo</td>
<td>57</td>
<td>2,847</td>
<td>790</td>
<td>280</td>
</tr>
<tr>
<td>BCEAO zone</td>
<td>3,473</td>
<td>42,145</td>
<td>15,140</td>
<td></td>
</tr>
<tr>
<td>Cameroon</td>
<td>475</td>
<td>9,562</td>
<td>7,640</td>
<td>800</td>
</tr>
<tr>
<td>C.A.R.</td>
<td>620</td>
<td>2,470</td>
<td>690</td>
<td>280</td>
</tr>
<tr>
<td>Chad</td>
<td>1,284</td>
<td>4,747</td>
<td>360</td>
<td>80</td>
</tr>
<tr>
<td>Congo</td>
<td>342</td>
<td>1,768</td>
<td>2,180</td>
<td>1,230</td>
</tr>
<tr>
<td>Equa. Gui.</td>
<td>28</td>
<td>360</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gabon</td>
<td>267</td>
<td>695</td>
<td>2,950</td>
<td>4,250</td>
</tr>
<tr>
<td>BEAC zone</td>
<td>3,016</td>
<td>19,602</td>
<td>13,820</td>
<td></td>
</tr>
</tbody>
</table>

Source: Banque de France, 1983
Table 2.2
Growth Performance of Franc Zone Countries in Africa

<table>
<thead>
<tr>
<th>Country</th>
<th>GNP per capita Dollars 1987</th>
<th>Average Annual growth rate % 1973-80</th>
<th>1980-87</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chad</td>
<td>150</td>
<td>-3.5</td>
<td>2.4</td>
</tr>
<tr>
<td>Burkina Faso</td>
<td>190</td>
<td>2.5</td>
<td>2.5</td>
</tr>
<tr>
<td>Niger</td>
<td>260</td>
<td>2.6</td>
<td>-4.9</td>
</tr>
<tr>
<td>Togo</td>
<td>290</td>
<td>1.5</td>
<td>-3.9</td>
</tr>
<tr>
<td>Benin</td>
<td>310</td>
<td>-0.3</td>
<td>-0.6</td>
</tr>
<tr>
<td>C.A.R.</td>
<td>330</td>
<td>-0.5</td>
<td>-0.7</td>
</tr>
<tr>
<td>Senegal</td>
<td>520</td>
<td>-0.5</td>
<td>0.1</td>
</tr>
<tr>
<td>Côte d'Ivoire</td>
<td>740</td>
<td>1.2</td>
<td>-3.5</td>
</tr>
<tr>
<td>Congo</td>
<td>870</td>
<td>1.1</td>
<td>1.7</td>
</tr>
<tr>
<td>Cameroon</td>
<td>970</td>
<td>5.7</td>
<td>4.5</td>
</tr>
<tr>
<td>Gabon</td>
<td>2,700</td>
<td>-1.2</td>
<td>-3.5</td>
</tr>
</tbody>
</table>

*Source: World Bank*
CHAPTER 3

FISCAL POLICY IN PRIMARY COMMODITIES EXPORTER LDC'S:
AN EMPIRICAL INVESTIGATION OF THE FRANC ZONE COUNTRIES

3.1 Introduction

As has been seen in Chapter 1, changes in commodity export prices have played an important role in explaining the economic performance of industrial and of developing countries. For most countries, fluctuations in the international prices of the main commodity exports have important implications for government revenues since the government is likely to either own the production facilities (e.g., Nigeria for oil) or to have set up a price stabilization fund (e.g., Côte d'Ivoire for coffee). Furthermore, trade taxes are often an important source of revenues. Increased export revenues, following a commodity boom, usually result in a balance-of-payments surplus and an accumulation of international reserves.

Typically, following a commodity boom, primary commodities exporter LDC's have experienced a surge in government expenditures which continued in spite of the subsequent decline in the price of

\[ \text{footnote} \]

\[ ^{1} \text{I gratefully acknowledge helpful discussions with Roland Bénabou, Andrew Bernard, Shantayanan Devarajan, Rudiger Dornbusch and Stanley Fischer. All remaining errors are mine alone.} \]

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primary commodities. A survey of commodity booms for several developing countries (Colombia\textsuperscript{2}, Cameroon, Kenya, Nigeria and Jamaica) can be found in Cuddington (1989) who generalizes from countries' experience by concluding that

"there has been a tendency to overspend during and following commodity export booms, which has considerably reduced realizable welfare gains...The ratchet effect of increased government spending during booms, which proves difficult to reduce once the booms subside, is common." (pp. 154-55).

A similar pattern exists for the Franc Zone countries in Africa. For example, in 1975-77, Côte d'Ivoire experienced the coffee/cocoa boom (tripling of prices in 2 years) during which the government started an ambitious public investment program which continued in spite of the reversing trend in the coffee/cocoa prices. This led to the accumulation of foreign debt (73\% of GDP in 1987 versus 35\% of GDP in 1980). By 1980, the public sector deficit had reached 12\% of GDP. In Niger, the government and its creditors did not react to the collapse of uranium prices in the early 1980's and fiscal policy remained expansionary until 1983. Although Senegal did not experience the same magnitude of fluctuations in its term of trade as the rest of the West African Monetary Union countries, it nevertheless continued its expansionary policy, maintaining private consumption and expanding

\textsuperscript{2}More detailed work for Colombia and the coffee boom is available in Cuddington (1986).
public consumption, when the price of phosphate fell.

This brief review of the experience with commodity booms of some Sub-Saharan African countries suggests that in many cases countries may even find themselves worse off after the boom and that their responses have not been optimal\(^3\) (in the sense of not using periodic surge in export commodity prices to restore external balance and promote economic growth).

The purpose of this chapter is to analyze fiscal policy in primary commodities exporter developing countries. The chapter characterizes the environment in which fiscal policy decisions are made by introducing three effects (pressure to spend, limited disinvestment or policy reversal and limited indebtedness) and suggests that these three effects may explain the lack of consumption smoothing by the fiscal authorities\(^4\). It uses an

---

\(^3\)There are naturally some exceptions to this. Botswana and Cameroon limited the increase in government spending during the commodity booms. The experience of Cameroon (with a comparison with that of Côte d'Ivoire and Senegal) is reviewed in Devarajan and De Melo (1987).

\(^4\)To test the permanent income hypothesis for government expenditures, one can regress (see, Cuddington and Urzúa, 1987 for a similar approach) the logarithm of government expenditure (with separate regressions for consumption and investment expenditures) on a permanent and a cyclical component of the logarithm of government revenues (a decomposition of the logarithm of government revenues into a permanent and a cyclical component can, for example, be obtained by the Beveridge and Nelson (1981) method). However, the decomposition itself is meaningless unless a sufficiently large (and, if possible, not restricted to years covering a commodity boom and a commodity bust) number of observations is available. Furthermore, this testing approach is valid if government revenues can be assumed to be exogenous (i.e., no tax instrument available). This may be a reasonable approximation for lesser developed and highly primary commodities dependent African economies. It is also possible to test for an asymmetric fiscal response to commodities booms and busts by allowing for different coefficients whether the cyclical component is positive or negative.
optimizing model of government spending to look for evidence, using data for the Franc Zone countries in Africa, of the existence of these three effects and uses Euler equations for the unconstrained and the constrained version of the model to evaluate Lagrange multipliers for the constraint associated with the limited indebtedness effect.

3.2 Limitations to Fiscal Expenditure Adjustments and Government's Response

A positive (negative) terms of trade shock resulting from an increase (decrease) in the international price of a country's main export commodity or from a resource discovery (e.g., exploitation of new oil reserves for Cameroon) implies an increase (decrease) in wealth. Optimally, the government, if it has rational expectations and behaves according to the permanent income theory, should use commodity booms and busts to smooth its consumption expenditures. In particular, as argued by Cuddington (1988), the optimal response for an economy would be to estimate the present value of the windfall gain (loss) and to limit the increase (decrease) in consumption expenditures to the perpetuity equivalent of this windfall. However, as illustrated earlier with the experience of African countries, commodity booms are in most cases accompanied by excessive increases in consumption expenditures and by ambitious
investment programs. This has a tendency to lock countries into levels of spending which, in spite of their unsustainability (because of the resulting high level of foreign debt), are difficult to reverse.

Rejection of the permanent income hypothesis can naturally be explained if it can be argued that temporary booms were genuinely believed to be permanent or that governments operate with very short time horizons. The approach adopted by this paper is to characterize the environment in which a forward-looking infinitely lived government makes its fiscal decision and to look for evidence of the existence of operative constraints and/or costs faced by the government which may prevent it from behaving in a manner consistent with the permanent income theory. The characterization of the environment in which fiscal policy decisions must be made is described below.

Pressure to spend effect

If the public and/or the private sector face credit constraints which are relaxed during a boom, it is likely that there will be a surge in consumption expenditures at the onset of

---

5Investment in projects (preferably with low disinvestment costs if phasing out becomes necessary) with an internal rate of return (measured at appropriate shadow prices) that exceeds the country's opportunity cost of capital could be welfare enhancing. In practice, this is very unlikely to be the case (white elephants). Thus, although the permanent income theory defines optimal behavior as consumption smoothing (i.e., investing in projects is a form of savings), we ignore this and work with total government expenditures without distinguishing between consumption and investment expenditures.
the boom. However, even in the absence of credit constraints, the same effect on spending can be attained if the government finds itself unable to restrict expenditures once it is known that additional government revenues are available. In a country where there are a lot of unmet needs, special interest groups or government agencies may pressure the government into spending immediately a large amount of the increase in wealth if those groups or agencies feel uncertain whether they will be able to benefit from increased government spending if it is postponed.

Thus, the pressure to spend effect can be given a political economy cost interpretation. The constituents can exert pressure on the government (i.e. threat of political upheavals such as food riots or electoral defeat following the removal of subsidies on staple food or public transit) if it does not follow their desired fiscal policy.

The pressure to spend effect, expressed as a constraint on the budget's surplus, can, for example, be written as

\[ Y_{t+g} - G_{t+g} \leq S^* \quad (S^* \geq 0) \]  

(1)

We now examine a cost interpretation of the pressure to spend effect. There are two alternative views of how the pressure to

---

\(^6\)Cameroon, which avoided spending immediately its surplus from the coffee/cocoa (75-77) and oil boom, channeled the additional revenues (without divulging the amount) into accounts which did not figure in its government's budget.
spend arising from a commodity boom can manifest itself into a political crisis. One can either consider that the resulting crisis is an all or nothing event (with a fixed cost $C_1$, see Dornbusch, 1988) or that there can be different degrees (with increasing costs) in the seriousness of the crisis (e.g., a minor strike, a riot, a general strike or the overthrow of the government).

In the first case, an appropriate formulation for the expected cost is

$$E_t(C_1) = p_t(Y_t - G_t) C_1$$  \hspace{1cm} (2)

where $p_t$, the probability of a crisis occurring in period $t$ is an increasing function of the budget's surplus $Y_t - G_t$ for that period. We assume that $Y_t$ and $G_t$ are immediately known to the constituents (i.e., no lag on acquiring information)\(^7\).

In the second case, an expression for the expected cost is, for example,

$$E_t(C_1) = 1_{[Y_t - G_t > 0]} C_1 (Y_t - G_t), \quad C_1 \geq 0$$  \hspace{1cm} (2')

This formulation which we consider intuitively more appealing

\(^7\)The probability $p_t$ could also be expressed as a function of $Y_{t+1} - Y_t$ or of $(Y_{t+1} - Y_t)/Y_t$. However, the probability of the constituents acting on their threat of rioting should be related to their knowledge of the government's action and thus be a function of $G_t$. The constituents could also act on their threat with a lag, giving the government several periods to adjust its spending. This would only complicate the problem by adding lagged terms in the function $p_t$.  

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for the type of political crisis that is being discussed is selected for the empirical application\(^8\).

Note that the expected cost \( E(C_1) \) associated with the pressure to spend effect has a functional form which is consistent with the functional form selected for the corresponding constraint in the sense that its expected value is zero whenever the constraint is assumed to be non-binding (with \( S^* = 0 \)) and that it is an increasing function of the quantity on which the constraint is imposed\(^9\). This suggests that the expected cost \( E(C_1) \) should be expressed as the product of an indicator function (indicating whether or not a crisis occurs) and of a measure of the seriousness of the crisis, for example, the square of the difference between the government's chosen and the constituents' desired policy.

**Limited disinvestment or policy reversal effect**

The marked increase in government expenditures which typically follows a commodity boom can, for example, translate into investment spending on projects or into an increase in the size (and/or the wage) of the public labor force. Once this spending pattern is in place, it may become difficult to reverse. The government finds itself trapped by recurrent expenditures which are

\(^8\)It leads to a more tractable version of the model since the functional form for the cost (convex) does not have to be a probability.

\(^9\)Thus, \( C_1 \) is related to the strength of the pressure to spend effect and as such measures the extent to which the corresponding constraint is binding.
inflexible or even irreversible. Furthermore, the longer the
higher level of government spending has been sustained, the harder
a priori, it will be to reverse. Thus, the government faces policy
reversal costs (e.g., disinvestment costs for a project already
started, labor firing costs) which a priori increase with the level
of total expenditure (investment) and therefore increase with the
time span of the commodity boom. However, this effect could
theoretically become inexistent for an economy in which the
commodity boom has lasted sufficiently long so that either it is at
full capacity and firing costs are small (i.e., overemployment)
and/or the marginal investment projects have a lower internal rate
of return than the projects undertaken at the onset of the
commodity boom. This is unlikely, excluding perhaps some oil
exporters, to be the case for the majority of developing countries.

The limited disinvestment or policy reversal effect, expressed
as a constraint on government spending, can, for example, be
written as

\[ G_{t+s} - G_{t+s-1} \geq \omega \quad (\omega \geq 0) \quad (3) \]

which corresponds to a policy reversal interpretation.\(^{10}\) \(^{11}\)

\(^{10}\)Equation (3) means that there is pressure on the government whenever it
decreases the level of real government spending ($\omega = 0$). $\omega > 0$ can be justified
if policy reversal is defined in terms of real government spending per capita.

\(^{11}\)A limited disinvestment interpretation can, for example, be written as

\[ \frac{G_{t+s}}{K_{t+s-1}} \geq \rho \]

which is equivalent to imposing a lower bound on investment.
To formulate the limited disinvestment or policy reversal effect as a cost, that of contracting fiscal policy during a commodity bust, we once again assume that the political crisis (a function of the state of the economy and of the actions of the government) is of varying intensity and we ignore fixed cost formulations.

The nature of a crisis occurring (its likelihood and its magnitude) in period $t$ should be a function of the capital stock $K_{t-1}$ (i.e., the state of the economy at the beginning of the period) and of the government expenditures $G_t$ (again we postulate that the government's action influences the way the constituents respond). As has been explained earlier, the likelihood and/or the magnitude of a crisis occurring at the onset of an adjustment program adopted by the government should be increasing in $K_{t-1}$ (for example, cutting teacher's salaries is likely to be more disruptive if the number of teachers is high) and should be decreasing in $G_t$. Assuming away any lag in the constituents acquiring information about the economy and defining policy reversal by $G_t - G_{t-1} < 0$, the expected cost $E(C_2)$ can, for example, be expressed as

$$E_t(C_2) = 1_{G_t - G_{t-1} \leq 0} C_2(G_t, K_{t-1})$$

(4)

with

$$\frac{\partial C_2(G_t, K_{t-1})}{\partial G_t} \leq 0 \quad ; \quad \frac{\partial C_2(G_t, K_{t-1})}{\partial K_{t-1}} \geq 0$$

(5)
A simpler functional form, adopted for the empirical application, which is consistent with the constraint formulation of the limited disinvestment or policy reversal effect (for \( \omega = 0 \)) is given by

\[
E_t(C_2) = 1_{\{G_t - G_{t-1} \leq 0\}} C_2(G_{t-1} - G_t) ; \quad C_2' \geq 0
\]  \( (4') \)

Note that a priori, considering changes in government expenditures of equal magnitude, the cost of a political crisis triggered by a transition from a high level of spending to a low level of spending (i.e., adjustment) should exceed that of a political crisis triggered by the lack of transition from a low level of spending to a high level of spending. In the former case, the government requires its constituents to readjust their consumption level to a lower level (to which they may no longer be used to if the commodity boom has lasted sufficiently long) while in the latter case, it only requires its constituents not to switch to a higher consumption level (to which they are not yet accustomed).

**Limited indebtedness effect**

The third and last effect which characterizes the environment in which the government must set its fiscal policy is a credit rationing constraint.
At the onset of a commodity bust, as long as foreign financing is available, the country is able to sustain its spending pattern, thus avoiding the political costs of reversing its fiscal policy. Naturally, foreign reserves are depleted and/or the level of foreign debt rises. Sooner or later, the country will face a borrowing constraint on the international capital market and adjustment, often at the request of the lending institutions (e.g., IMF), will have to take place. Poor investment projects, substantial government's budget deficit and large external indebtedness will then make adjustment a lot more costly than it would have been, had the government been able to manage better (in the sense of behaving more closely to what is predicted by the permanent income theory) its commodity boom.

The limited indebtedness effect, expressed as a constraint on wealth, is written as

$$ A_{t-s} \geq -A^* $$  \hspace{1cm} (6)

### 3.3 Fiscal Policy Optimizing Model

The purpose of this section is to formulate a fiscal policy optimizing model which incorporates the three effects introduced above with the pressure to spend and the limited disinvestment or policy reversal effects expressed as costs and the limited indebtedness effect expressed as a constraint.
Our model of government's behavior is an expenditure choice model based on intertemporal optimization in a dynamic stochastic environment. The government's income $Y_t$ is a function of the international price $P_t^e$ of the main export commodity. Since $P_t^e$ is a general stochastic process, $Y_t$ is also a general stochastic process. We assume that the government maximizes a time separable utility function with an instantaneous utility function of real government expenditures $G_t$ for period $t$ and of services received from the beginning of period $t$ capital stock $K_{t-1}$. Assuming those services to be proportional to the capital stock, we have the following maximization problem:

$$
\text{Max } E_t \sum_{s=0}^{\infty} (1+\theta)^{-s} [U(G_{t+s}, K_{t+s})]
$$

subject to the capital and wealth accumulation equations

$$K_{t+s} = \gamma G_{t+s} + (1-\delta) K_{t+s-1}
$$

$$A_{t+s} = (1+r) A_{t+s-1} + Y_{t+s} - G_{t+s}
$$

and to the constraint equation (6)

$$A_{t+s} \geq -A^*$$
where

$E_t$ is the expectation conditional on information available at time $t$;

$U$ is the one period utility for consumption and services received from the capital stock;

$\theta$ is the constant rate of time preference;

$\gamma$ is the constant fraction of government expenditures allocated to investment;

$\delta$ is the constant rate of depreciation;

$r$ is the constant real rate of interest;

$Y_t$ is real government revenues; and

$A_t$ is the real end-of-period wealth.

The decision problem is sequential with the following timing. At the beginning of each period, the government learns $Y_t$. The government then reoptimizes by selecting $G_t$ for the period. This, in turn, determines $A_t$ and $K_t$. Thus, for this problem, the control variable is government spending $G_t$ and the state variables are the capital stock $K_t$ and the wealth $A_t$. $A_t$ should be thought of as liquid wealth. $K_t$ is not considered to be a part of wealth because the capital is assumed to have no resale value (once spent, investment is sunk).

Even without constraints, analytical solutions to the optimization problem when income is stochastic cannot in general be derived, except in some simplifying cases. (See, for example, Blanchard and Fischer, Chapter 6, 1989.) Nevertheless, we can write first-order conditions which are necessary for maximization
of the welfare function. The first-order conditions are derived from an application of the Kuhn-Tucker conditions to the Bellman equation.

The value function $W_t$ satisfies the following recursive equation (Bellman equation)

$$W_t(A_t, K_t) = \max_{G_t} \left[ U(G_t, K_t) + (1+\theta)^{-1} E_t(W_{t+1}(A_{t+1}, K_{t+1})) ight.$$

$$\left. - C_1 (Y_t - G_t) - C_2 (G_{t-1} - G_t) + \lambda_t (A_t + A^*) \right]$$

(10)

where $\lambda_t$ is the Lagrange multiplier (known at time $t$) associated with the borrowing constraint at time $t$. The Lagrange multiplier at time $t$ is equal to the increase in the objective function (from time $t$ on) if the corresponding (current) constraint is relaxed by one unit. If the constraint is binding, $\lambda_t$ should be positive since overall utility would increase if the government were able to borrow an extra dollar. It cannot be negative since, given the absence of an upper bound on wealth, the limited indebtedness constraint does not prevent the government from saving more.

To derive the Euler equation, we derive the first-order condition associated with the equation above, eliminate the value function by using the envelope theorem, push one period forward and apply rational expectations. Assuming, for ease of computation, that the real rate of interest is equal to the rate of time preference ($r = \theta$), that there is no depreciation ($\delta = 0$) and that
all government spending is allocated to some form of capital (γ = 1), we obtain the following equation:

\[
(1+x) \left[ U_t(G_t, K_t) - U_t(G_{t-1}, K_{t-1}) \right] \\
+ U_t'(G_t, K_t) - U_t'(G_{t+1}, K_{t+1}) \\
+ (1+x) \left[ U_{t-1}(G_t, K_t) - U_{t-1}(G_{t-1}, K_{t-1}) \right] \\
+ C_1'(Y_t - G_t) - C_1'(Y_{t+1} - G_{t+1}) \\
+(1+x) \left( C_1'(Y_t - G_t) - C_1'(Y_{t-1} - G_{t-1}) \right) \\
+ (1+x) \left( -C_2'(G_{t-2} - G_{t-1}) + C_2'(G_{t-1} - G_t) \right) \\
- C_2'(G_t - G_{t+1}) + C_2'(G_{t-1} - G_t) \\
- \lambda_{t+1} - \lambda_t - \pi \lambda_t \\
+ u_t + u_{t+1}
\]

where \( u_t \) and \( u_{t+1} \) are error terms with zero means and respectively uncorrelated with any information available at time \( t-1 \) and at time \( t \). All derivations are shown in Appendix 1.

3.4 Description of the Test

Zeldes (1989) shows that empirical rejections of the permanent income theory can be explained by the presence of liquidity constraints. He derives the Euler equations for a consumption optimizing model with and without borrowing constraints and tests whether borrowing constraints are binding by testing whether the unconstrained Euler equations are violated. This approach follows
Hall (1978). The advantage of testing Euler equations is that it is not necessary to specify the stochastic process for the exogenous variable (in our case government revenues) and that it is not necessary to obtain a closed form solution for consumption (i.e. fiscal policy). (See, for example, Mankiw (1985).)

A currently binding constraint leads to the violation of the unconstrained Euler equation. We do not have a closed form expression for the Lagrange multiplier. It should be a function of the state variables at t and of expected values of these variables from time t+1 on\(^{12}\). Therefore, since the Lagrange multiplier appears in the error term, estimation of equation (11) with a data set that includes constrained observations (i.e., observations for which at least one of the constraint is binding) will lead to inconsistent parameter estimates.

As a consequence, it is necessary to split the sample of observations into two groups: one for which the borrowing constraint is a priori not binding and the other one for which the constraint is a priori binding\(^{13}\). Estimation of the Euler equation for the data set restricted to unconstrained observations will

\(^{12}\)Since \(K_{t+1}\) can be expressed as a function of \(K_t\), \(A_t\), \(A_{t+1}\) and \(Y_{t+1}\), \(K_{t+1} = Y_t((1+r)A_t + Y_{t+1} - A_{t+1}) + (1-\delta)K_t\).

\(^{13}\)Note that even if unconstrained observations are included in the group of constrained observations (and therefore, excluded), the parameter estimates will still be consistent but that if one or more constrained observations are included in the group of unconstrained observations, the parameter estimates will be inconsistent.
yield consistent parameter estimates.

The test of liquidity constraint is based on an estimator of the error term of the constrained Euler equation. This estimator is obtained by getting a numerical estimate of the residual in equation (11) using the consistent parameters obtained by the estimation of that same equation for the unconstrained observations.

These numerical estimates of the residuals are the sum of the expression involving the Lagrange multipliers in the right hand side of equation (11), the true residual and an error term. If the sample is large enough, the sample means of the true residual and of the error term will converge to zero and, by averaging the numerical estimates of the residuals, we will obtain an estimate of the average of the expression involving the Lagrange multipliers in the right hand side of equation (11) for the group of constrained observations.

Taking the average over T observations of the residual of equation (11), we obtain\(^{14}\)

---

\(^{14}\)Note that there are realizations of \(Y\), such that the model with the three effects expressed as constraints does not have a solution. (The three constraints may be simultaneously binding and inconsistent with each others.) However, as long as borrowing constraints are absent (although borrowing costs may become very high), it is possible to formulate the model with the pressure to spend and the limited disinvestment or policy reversal effects expressed as constraints. In that case, it can be shown that the Lagrange multipliers associated with these two constraints always appear as a difference in the residual (i.e., multiplier at time \(t\) - multiplier at time \(t-1\)) and therefore, that it is impossible to obtain an estimate of the average of these multipliers.
\[ \frac{1}{T} \left[ \lambda_{T+1} - \lambda_1 - r \sum_{s=1}^{s-T} \lambda_s \right] \quad (12) \]

3.5 Estimation Results

The model is tested for Franc Zone countries in Africa. Government statistics for African countries are very poor and data on government revenues and expenditures are especially scarce. Relying on the International Financial Statistics (IMF), the African Economic and Financial Data (World Bank) and World Bank country reports, government expenditure and revenue\textsuperscript{15} data were retrieved for the following countries and for the following years: Burkina Faso (1973-87); Cameroon (1975-87); Côte d'Ivoire (1969-87); Gabon (1973-76 and 1979-87); Senegal (1977-1987); and, Togo (1977-87). Variables for which we had several data source were systematically checked for consistency. Given the lags in the Euler equation (t-2, t-1 and t+1), an observation qualifies for inclusion in the data set if data for the preceding two years and for the following year is also available. The final data set available to test the model includes 61 observations. Finally, the capital K variable had to be constructed. Since no data on capital stocks were available, a time series for K was constructed (using

\textsuperscript{15}In some cases, data on government revenue was unavailable. However, a figure could be constructed using data on government's expenditures and primary deficit.
available investment data) starting in 1960\textsuperscript{16} using an initial capital output ratio of 5 and a depreciation rate of 5 percent. Taylor (1979) suggests as a rule of thumb a depreciation rate of 4% and a capital output ratio of 3. Since he is referring to developing countries as a whole, slightly higher figures are selected for African countries.

The criteria used for splitting the data is as follows:

i) the limited indebtedness constraint is assumed to be binding whenever real net foreign assets of the monetary sector\textsuperscript{17} are negative or low\textsuperscript{18}.

Real net foreign assets of the monetary sector is not what the wealth variable A is supposed to measure. However, it is a priori the case that the government faces a liquidity constraint whenever real net foreign assets are low. In particular, the absence of a market for government bonds in the Franc Zone prevents open market

\footnote{\textsuperscript{16}K is built recursively as 
\[ \text{K}_t = \text{K}_{t-1} (1-\delta) + \text{I}_t \text{ with } \text{K}_{00} = 5 \text{ Y}_{00}. \]
Although all series, except Côte d'Ivoire which starts in 1969, start in 1973 or after, the capital serie was initialized in 1960 in order to reduce sensitivity to the choice of the initial capital output ratio.}

\footnote{\textsuperscript{17}Avoirs Exterieurs (Net)}

\footnote{The notion of "low" is itself ad hoc. However, for each country, time series observations for the wealth variable were such that the difference between the largest value for which the observation was rejected (i.e., constraint assumed to be binding) and the smallest value for which the observation was not rejected was substantial (i.e., well in excess of the magnitude of the largest of the "low" values). Furthermore, excluding observations with a negative wealth or with a negative or "low" wealth did not produce very different results. Therefore, since the larger number of observations in the first case implies more degrees of freedom, the criteria adopted for splitting the data is that of excluding observations with a negative wealth variable.}

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operations. Therefore, all government borrowing is essentially foreign, either directly through the central bank or indirectly through public enterprises which in turn borrow abroad\(^{19}\). Thus, the real net foreign asset variable is an indicator of the latent wealth variable A.

Note that when a constraint is binding at time \(t\), more than one observation must be eliminated since the corresponding Lagrange multiplier also appears in the error term at time \(t-1\) and at time \(t+1\).

Using the criteria above, 31 observations had to be eliminated on the basis of wealth alone and the unconstrained Euler equation data set which can a priori be used for estimation has 31 observations.

The model is specified as follows.

Both utilities are assumed to be quadratic with

\(^{19}\)See, Chapter 2.
\[ U(G_t, K_t) = A - \frac{\alpha}{2} (G_t - \overline{G})^2 - \frac{\beta}{2} (K_t - \overline{K})^2 \]  

(15)

where \( G \) and \( K \) are country specific\(^\text{20}\).

Alternatively, we could assume the instantaneous utilities to be of the constant elasticity of substitution form. However, meaningful convergence results were difficult to obtain with this specification.

The costs are also assumed to be quadratic with

\[ C_1(Y_t - G_t) = 1_{[Y_t-G_t \geq 0]} \frac{\lambda}{2} (Y_t - G_t)^2 \]  

\[ 1_{[Y_t-G_t \geq 0]} = 1 \text{ if } Y_t - G_t \geq 0 ; 0 \text{ otherwise} \]  

(16)

\[ C_2(G_t, G_{t-1}) = 1_{[G_t-G_{t-1} \geq 0]} \frac{\mu}{2} (G_{t-1} - G_t)^2 \]  

\[ 1_{[G_t-G_{t-1} \geq 0]} = 1 \text{ if } G_t - G_{t-1} \geq 0 ; 0 \text{ otherwise} \]  

(17)

where the indicator functions are constructed as dummies using data for each country on \( Y_t, G_{t-1} \) and \( G_t \). (An exponential formulation for the costs (i.e. \( \lambda \exp(Y_t - G_t); \mu \exp(G_{t-1} - G_t) \), does not require the

\(^{20}\)Note that \( G \) and \( K \) require time subscripts if it is deviations from the respective permanent components which are penalized. However, a meaningful value of \( G \) (and of \( K \) constructed, for example, by using a permanent decomposition of public investment) can only be obtained if we have enough observations. For simplicity, we ignore that differences in the permanent components from one period to the next appear in the first-order condition.
use of indicators (dummies) and is such that the costs are non zero for all observations.)

Under these assumptions, the unconstrained Euler equation becomes (for each country, \( K \) and \( G \) cancel out):

\[
\beta (1+r) (K_t - K_{t-1}) + \alpha (G_t - G_{t+1}) + \alpha (1+r) (G_t - G_{t-1}) \\
+ \lambda 1_{[Y_t=1, G_{t+1} \leq 0]} (Y_t - G_t) \\
- \lambda 1_{[Y_t=1, G_t \leq 0]} (1+1+r) (Y_t - G_t) \\
+ \lambda 1_{[Y_{t-1}=1, G_{t-1} \leq 0]} (1+r) (Y_{t-1} - G_{t-1}) \\
+ \mu 1_{[G_{t+1} \leq 0]} (G_{t+1} - G_t) \\
- \mu 1_{[G_{t-1} \leq 0]} (1+1+r) (G_{t-1} - G_t) \\
+ \mu 1_{[G_{t-2} \leq 0]} (1+r) (G_{t-2} - G_{t-1}) \\
= 0
\]

(18)

Note that since a utility function is defined up to an affine transformation, neither \( A \) (which does not appear in the equation) nor \( \alpha \) (or \( \beta \)) are identified. Therefore, setting \( \alpha \) equal to 1, there are three parameters to be estimated\(^{21}\):

- \( \beta \) a utility parameter;
- \( \lambda \) a cost parameter for the pressure to spend effect; and

\(^{21}\)The estimation results are not very sensitive to the choice of the discount rate. The discount rate (equal to the rate of time preference) selected is 10 percent.
μ a cost parameter for the limited disinvestment effect\textsuperscript{22}.

The stochastic Euler equation that must be satisfied in equilibrium implies orthogonality conditions that depend in a non-linear way on the variables and on the unknown parameters. Estimation of the model is done by Non Linear Least Squares. However, given the presence of \( u_t \) in the error term, consistency of the parameter estimates require the use of a generalized instrumental variables method.\textsuperscript{23} The estimation technique used follows Hansen (1982) and Hansen and Singleton (1982).

As argued in Hansen (1982), the method of moments estimator used is consistent even when the disturbances are serially correlated and the instruments are not exogenous. However, the asymptotic covariance matrix of the estimates depends on the choice of the symmetric positive definite matrix used to construct the

\textsuperscript{22}Note that the three parameters above are actually all measured relative to \( \alpha \) (i.e., \( \beta/\alpha, \lambda/\alpha \) and \( \mu/\alpha \)) and are also (since the first-order condition is homogeneous of degree one) independent of the unit in which all variables are expressed. The parameters can be given the following interpretation. Let \( C_Q \) designate the disutility of government spending deviating from \( G \) by an amount \( Q \). Then, the disutility associated with the pressure to spend effect for a surplus in the amount of \( Q \) is \( \lambda C_Q \) while the disutility associated with the limited disinvestment or policy reversal effect for a reversal of policy in the amount of \( Q \) is \( \mu C_Q \). A more interesting quantity is the ratio \( \mu/\lambda \) which measures the relative importance of the costs and which a priori, as has been argued earlier, should be greater than one. An alternative formulation is to write all the quantities in terms of percentage of GDP. However, the results obtained were not satisfactory (insignificant parameters). In any case, we are more interested in testing whether the parameters are of the expected sign and different from zero rather than measuring their magnitude.

\textsuperscript{23}The Euler equation is of the form \( E_t(f(x_{t+1}, \beta)) = 0 \) where \( f(x_{t+1}, \beta) \) is a vector of residuals. The use of instruments \( z_t \) means that we are minimizing a quadratic form of residuals which have been projected \( (f(x_{t+1}, \beta) \otimes z_t) \) into the vector space generated by the instruments \( z_t \).
"distance" which is minimized. Newey and West (1987) show that if the highest order $m$ of zero non correlation in the error term is non zero, the asymptotic covariance matrix used by Hansen and Singleton (1982) may be inadequate. This interferes with asymptotic confidence interval formation and hypothesis testing\textsuperscript{24}.

As indicated earlier, the parameter estimates are not very sensitive to the value selected for $r$ (a grid search with $r$ varying in increment of 5 percent from 5 percent to 35 percent was conducted). Note that even with $r$ fixed, the Euler equation remains non linear since the costs themselves are non linear. For example, with $G_{t,1}$ as the dependent variable, the coefficient of $G_t$ is (the indicator functions being constructed as dummies)

\textsuperscript{24}Given the way observations from different time periods and from different countries are combined, the covariance structure is complicated. Since the model is estimated after a set of \textit{a priori} constrained observations has been selectively deleted, the estimation data set is such that for each country the observations are not necessarily consecutive observations. This makes it very difficult to assume a common correlation structure (across time). AR(1) processes were fitted for the residuals (by countries) obtained for each model and did not indicate (except for three observations for Côte d'Ivoire) strong first-order correlations ($\rho$ of the magnitude of 0.3 and insignificant). Furthermore, since the countries of the sample depend on different products for their exports and since the prices of these commodities are not very closely correlated (see, Honohan, 1990b), we can assume the commodities price shocks to be uncorrelated across countries. Since the countries in the sample are all in the Franc Zone, their monetary shocks are correlated and they share exactly (assuming away differences in the pattern of trade with countries other than France) the same exchange rate shocks. However, the majority of deleted observations corresponded to time periods of greater exchange rate volatility (i.e., greater variance) and the estimation data set is such that the most important component of the shocks should be the commodities price shocks.

Thus, we assume $m=0$ and the estimation procedure adopted is the generalized instrumental variables method of Hansen of Singleton (1982) which is consistent and robust to both heteroscedasticity and serial correlation. (For $m=0$, Newey and West' and Hansen and Singleton' asymptotic covariance matrices coincide.)
\[
\frac{(2+r) \left[ 1 + \lambda 1_{[Y_t-G_t \geq 0]} + \mu 1_{[G_t-G_{t-1} \leq 0]} \right] + \mu 1_{[G_{t+1}-G_t \leq 0]} }{1 - \lambda 1_{[Y_{t+1}-G_{t+1} \leq 0]} - \mu 1_{[G_{t+1}-G_t \leq 0]}}
\]

For \( r = 0.10 \), the parameter estimates (t-statistics in parentheses) are as follows

\[
\begin{align*}
\beta & \quad 0.086 \quad (1.68) \\
\lambda & \quad -0.50 \quad (0.52) \\
\mu & \quad 1.70 \quad (1.80)
\end{align*}
\]

Given the functional form of the cost functions, it is very difficult to obtain significant estimates for the cost parameters since a large share of the observations for which the cost dummies are zeros have a zero cost\(^{25}\).

Since the coefficient for the cost \( C_t \) is a priori expected to be significant, it may be that something else other than the budget surplus, and in particular a price signal (e.g., difference in the price of the main export commodity from one period to the next), determines the pressure to spend effect\(^{26}\). However, assuming that the cost is exclusively a function of a difference in price is not

\(^{25}\) Prior to selectively deleting a priori constrained observations, the cost \( C_t \) is non zero for only 20 (out of 54 and not 60 due to the use of instruments) observations (out of which 11 remain in the estimation data set) and the cost \( C_2 \) is non zero for only 20 observations (out of which 13 remain in the estimation data set). This is the rationale for the exponential functional form of the costs given above. Unfortunately, convergence was difficult to obtain with the exponential formulation.

\(^{26}\) Note that since we are working with Euler equations, we cannot test for the presence of a cost \( C_t \) which is exclusively a function of exogenous variables.
satisfactory since presumably the government's fiscal policy does affect whether or not and to what extent the pressure to spend effect manifests itself. This suggests to keep the same functional form for the cost $C_1$ but to express the coefficient $\lambda$ as a function of the magnitude of the change in the export unit value

$$\lambda (1+1_{[P_{t}^{C^*} - P_{t-1}^{C^*}]}(P_{t}^{C^*} - P_{t-1}^{C^*}))$$

which gives the following results:

- $\beta = 0.083$ (1.50)
- $\lambda = 0.88$ (1.05)
- $\mu = 1.98$ (2.21)

$\lambda$ is now positive and (although still insignificant) more significant than before.

Finally, since the estimation results seem to indicate that the cost $C_1$ associated with the pressure to spend effect may not play a very significant role, the model is reestimated assuming that the parameter $\lambda$ is zero which gives the following results:

- $\beta = 0.10$ (2.48)
- $\mu = 1.28$ (2.75)

The parameter estimates above are of the expected sign and are significant. Given the nature of the data (poor quality and scarcity of observations) and the econometric techniques involved in estimating the model, the results above are reasonable and consistent with the predictions of the model. In particular, the
results support the hypothesis of a limited disinvestment effect since the estimated Euler equation is consistent with that of the optimizing model presented in the paper for which the limited disinvestment effect is expressed as a cost of policy reversal.

The same model estimated on the entire set of observations yields the following parameter estimates:

\[ \beta \quad 0.023 \quad (0.74) \]
\[ \mu \quad 0.46 \quad (1.12) \]

The poor significance level and the substantial changes in the magnitude of the coefficients suggest the parameters are inconsistent due to misspecification\(^{27}\) (i.e., the unconstrained Euler equation is not valid for the entire data set since the Lagrange multipliers for the constrained observations are non zero). We now turn to computing an estimate of the average of the Lagrange multipliers associated with the limited indebtedness constraint.

For Côte d'Ivoire, observations up to 1975 have a positive wealth variable and are included in the data set. From 1976 until 1986 (except for 1978), the wealth variable is negative. Averaging the residuals from 1975 ($\lambda_1 = 0$) to 1985 ($\lambda_{1986} = \lambda_{12} \neq 0$), we obtain

\(^{27}\)This is an informal specification test. The hypothesis $H_0$ that our model is well specified for the restricted data set cannot be tested by itself. However, assuming $H_0$ to be true, we can reject the hypothesis $H_1$ that the same model specification is valid for the entire data set. The results above clearly indicate that $H_1$ should be rejected.
(in billions of 1985 CFA Francs) -0.027 which in turn is an estimate of

$$\frac{1}{11} [\lambda_{12} - 0.1 \sum_{s=2}^{s=11} \lambda_s]$$

Therefore, solving the equation above, we obtain the following positive (a priori \( \lambda_{12} \) is positive) estimate of the average of the Lagrange multipliers from 1976 to 1985

$$\sum_{s=2}^{s=11} \lambda_s = 10\lambda_{12} + 2.99$$

The above results naturally need to be interpreted cautiously since we are far from dealing with a large sample. However, the expected positive value of the average of the indebtedness constraint Lagrange multipliers for observations which are believed to be a priori constrained and the fact that estimation of the same model on the full data set leads to very different parameter estimates are evidence that the unconstrained Euler equation is misspecified for the observations which were selectively deleted on the basis of the wealth variable and that the source of the
misspecification is the presence of liquidity constraints.

3.6 Conclusions

The purpose of this chapter has been to analyze fiscal policy behavior in primary commodities exporters. The chapter suggests that the typical surge in fiscal expenditures which accompanies a commodity boom and the tendency to maintain that level of expenditures in spite of a subsequent decline in export commodity prices may be explained by the existence of a pressure to spend, a limited disinvestment and a limited indebtedness effects. These three effects characterize the environment in which fiscal policy must be set.

The estimation results suggest that the pressure to spend effect may not play an important role but that policy reversal costs and liquidity constraints are likely to play a role in

\[ \sum_{s=1}^{6} \lambda_s = 10(\lambda_7 - \lambda_1) - 1.25 \]

which is inconclusive. For Burkina Faso, for which the 1977 and the 1984 observations are a priori unconstrained and all the observations in between a priori constrained, we obtain (with \( \lambda_{1977} = \lambda_1 = 0 \) and \( \lambda_{1984} = \lambda_8 = 0 \))

\[ \sum_{s=2}^{7} \lambda_s = 0.299 \]

which is again consistent with the existence of liquidity constraints since the estimate of the average of the Lagrange multipliers over the 7 years period is unambiguously positive.
explaining the behavior of fiscal policy in the Franc Zone countries in Africa.

Additional work applying the same techniques on a richer data set for the Franc Zone countries or on data for other primary commodities exporter countries is suggested.

Additional research along the lines of the political economy models explaining timing of stabilization (see, for example, Drazen and Helpman 1988, Alesina and Drazen 1989, Drazen 1990) is also suggested to understand why these effects exist and what are the forces behind them.
CHAPTER 4

DETERMINANTS OF INFLATION AMONG FRANC ZONE COUNTRIES IN AFRICA

4.1 Introduction

As can be seen in Table 4.1 and as can be expected, the inflation rates in the Franc Zone countries are much lower than in other developing countries. In addition to lower overall inflation, one would expect little difference among inflation rates within the zone. Perfect capital mobility between the countries implies convergence of real interest rates and thus of inflation rates if nominal interest rates are aligned (in the absence of country-specific risk premia). In practice, however, capital movements within the CFA Zone are restricted and the interbank market is not sufficiently developed to enable perfect arbitrage among various financial instruments. Thus, and in spite of the fact that labor mobility is very high between the CFA countries, there can still be, as can be seen from Table 4.2, inflation differentials among member countries of the CFA Zone.

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1This chapter corresponds to a paper with the same title co-authored with Shantayanan Devarajan. The paper was prepared for the World Bank. We are grateful to Stanley Fischer for comments on an earlier draft and to Ajay Chhibber for comments and partial financial support. The views expressed in this chapter are the authors' own and do not necessarily reflect those of the World Bank.

2For example, transferring funds to France is subject to fees and often involves substantial delays. Also banks themselves do not act as intermediary between regions where there is a shortage of funds and regions where there is a surplus.
This chapter, divided in three parts, analyzes inflation differentials in the Franc Zone. In the first part, the existence of inflation differentials is verified by analyzing and conducting tests on the data. The second part develops a model of the determination of the price level in the CFA countries which incorporates important institutional aspects of macroeconomic policy in the CFA Zone. The third part tests the model empirically and conducts a simulation with the model.

The main question addressed is whether inflation differentials can be explained by the choice of adjustment policies made by the member countries of the monetary union. More specifically, given the countries' reliance on primary exports, the chapter aims at testing whether the differences in inflation rates reflect different fiscal policy responses to changes in the international price of the main export commodity.

It is shown that the changes in the export commodity prices have important effects on the domestic price level and therefore on the real exchange rate. Thus, a commodity boom will translate into inflation through a monetary effect (due to the unsterilized increase in foreign reserves) and through a fiscal effect (due to increased government spending, especially investment).
4.2 Inflation Differentials in the Franc Zone

The purpose of this section is to evaluate whether there are inflation differentials in the CFA Zone. More specifically we test whether there are long-run relationships between price levels in the two zones, between prices levels in France and in the CFA countries, among price levels in the BCEAO zone and finally, among price levels in the BEAC zone.

First, unit root tests are performed for each price level\(^3\). We use an Augmented Dickey-Fuller test (with two lags) which is based on least squares estimation of the following regression equation

\[ \Delta X_t - \beta X_{t-1} + \epsilon \]

where the null hypothesis, \( H_0 (\beta = 0) \) is no stationarity. The regression equation above is run for the price levels and the logarithm of the price levels and the first two differences of these variables. As documented in Engle and Granger (1987), the distribution of the t-statistic for the coefficient \( \beta \) is non-standard. The 99 (respectively 95) percent confidence level for rejection of non-stationarity is 3.77 (respectively 3.17). Tests

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\(^3\)Data consist of yearly observations (all between 1960 and 1988) ranging from 29 observations for France and Burkina-Faso to 23 for Senegal and 21 for Cameroon.
for higher order stationarity are only relevant if all the lower order stationarity tests failed. The results show all price levels and their logarithms to be I(2) (second order stationarity) except for Burkina-Faso for which we have first order stationarity (and therefore, a stationary inflation rate).

Next, cointegration tests are performed for price levels which have the same order of integration. The test, following Engle and Granger (1987), is an Augmented Dickey-Fuller test on the residual of the cointegration equation

\[ y_t - \beta x_t + c + e_t \]

where \( x_t \) and \( y_t \) are the variables for which cointegration is tested and \( c \) is a constant. Table 4.3 shows the results of the cointegration tests which are conducted between France and the two most important countries of each of the unions, Côte d'Ivoire (which accounts for 38 percent of BCEAO GDP) and Cameroon (which accounts for 60 percent of BEAC GDP), between Côte d'Ivoire and Cameroon, between BCEAO countries (excluding Burkina-Faso) and Côte d'Ivoire and, between BEAC countries and Cameroon. Cointegration is always rejected except between France and Côte d'Ivoire and between Senegal and Côte d'Ivoire.

Therefore, there is evidence of inflation differentials among the Franc Zone countries in Africa. This can be seen in Figures
4.1 - 4.4, which plot inflation rates among various combinations of CFA countries and France. Although Honohan (1990b) rejected cointegration between the French and CFA Zone price levels, he nevertheless argued for inflation convergence based on his principal components analysis. This analysis showed that half of the variance of the zone members' inflation rates could be explained by a common factor (the principal component). Honohan (1990b) then assumed this factor to be French inflation. Since the principal component analysis only accounted for half the variance, it is worth investigating what might explain the other half. Furthermore, the convergence of inflation rates described by Honohan (1990b) is a long-run phenomenon. We are interested in explaining inflation differentials in the short-run. We turn therefore to a model which interprets these differences in terms of fiscal policy responses to commodity price booms.

4.3 A Model of Inflation Differentials in the Franc Zone

The starting point of our analysis is the definition of the price level in a CFA country as:

\[ P = P_M^aP_N^{1-a}\]

where \( P_M \) is the domestic price of imports and \( P_N \) is the domestic price of all other goods consumed in the economy.

Thus, the inflation rate is a weighted average of the inflation rates of nontradables and imported goods. The domestic
price of imports, in turn, is equal to the nominal exchange rate multiplied by the world price (absent any trade taxes.) Since the nominal exchange rate in a CFA country is fixed, domestic policymakers have little control over the price of imports. Furthermore, import prices are likely to move in tandem across CFA countries, so that this component will not explain inflation differentials. Hence, the focus of our investigation will be movements in $P_N$. Recall that we classify as "nontradables" all goods in the consumption basket which are not imported. We therefore include import substitutes. This is justified by the fact that, in most of these countries, the domestically produced good is only an imperfect substitute for the imported good. Consequently, the domestic price of this substitute good is determined by domestic demand and supply conditions, rather than by the world price of the imported good. In what follows, we present a model of how $P_N$ is determined in a fixed-exchange rate regime that is subject to periodic shocks in its external terms of trade.

Most of the member countries of the zone are dependent upon exports of primary commodities for foreign exchange. These commodities are also the main source of government revenues, as the government sets the producer price below the world market price, with the difference accruing to a marketing board. A surge in the world price of this commodity has two effects. The first can be called the fiscal effect: the commodity boom is accompanied by a surge in government expenditures which continues in spite of the
subsequent decline in the price of primary commodities. The second can be termed the monetary effect: the pooling of reserves and the maintenance of a fixed exchange rate results in incomplete sterilization of the foreign exchange. The domestic money supply rises following the boom. Fluctuations in commodity prices, through these effects, ultimately cause changes in the domestic price level.

Specifying the Model

It is assumed that there are three goods in the economy: a primary commodity C which is not consumed domestically, imports M and non tradables N.

The notation used is the following:

\[ A_t \] = productivity variable;
\[ H_t \] = nominal money;
\[ R_t \] = nominal net foreign assets in CFA francs;
\[ Cr_t \] = total domestic credit;
\[ Z_{1t} \] = nominal net foreign transfers in CFA francs;
\[ Z_{2t} \] = nominal capital account in CFA francs;
\[ P_{t}^{ce} \] = international price of main export commodity;
\[ P_{t}^{m} \] = foreign price of imports;
\[ P_{t}^{n} \] = domestic price of imports;
\[ T_t \] = nominal government revenues;
\( G_t \) = nominal government expenditures (including investment);
\( G_{it} \) = nominal government expenditures (excluding investment);
\( \tau_{ct} \) = tax rate on commodity exports;
\( \tau_{mt} \) = tax rate on imports;
\( E_t \) = nominal exchange rate defined as CFA francs per dollar;
\( P^N_t \) = domestic price of non tradables;
\( P_t \) = domestic price level.

\( A_t, Z_{1t}, Z_{2t}, P^c_t, P^w_t, \tau^H_t \) and \( E_t \) are exogenous while the remaining 10 other variables are endogenous. All Greek letters represent parameters of the model. For any variable \( x \),

\[
\dot{x} = \frac{dx}{dt}
\]

A model which analyzes the impact of the fluctuations of the international price of coffee for Colombia can be found in Edwards (1986). A common feature of that model and ours is that terms of trade changes affect the money supply.

A dependent economy model for the CFA countries is proposed and empirically tested in Devarajan and de Melo, (1987b). Their model focuses on the adjustment needed in real variables to correct an external deficit. It ignores monetary aspects and treats government spending as exogenous. It is shown that alternative assumptions about the labor market (full employment or real wage rigidity) do not alter the qualitative nature of the results.
Therefore, since our model aims at capturing the effects of the fluctuations of the main export price commodity on domestic inflation (and thus, on real exchange rate), labor market and wage behavior issues are ignored. The nominal wage is assumed to be constant\(^4\).

The monetary side of the model is represented by equations (1) through (3) below.

\[
\dot{\hat{R}}_t = (1 - \omega) \hat{R}_t + \omega \hat{C}_t \\
\hat{C}_t = \hat{R}_t
\]

\[
\hat{R}_t = \rho \hat{R}_{t-1} - \phi_1 \hat{Z}_{1t} + \phi_2 \hat{Z}_{2t} + \psi_1 (\hat{P}^e_{t-1} + \hat{C}) - \psi_2 (\hat{P}^m_{t-1} + \hat{M})
\]

Equation (1) comes from the balance sheet of the monetary authorities, namely, the identity that base money equals net foreign assets plus domestic credit. Thus, the percentage change in money is equal to a weighted share of the percentage change in net foreign assets and of the percentage change in domestic credit.

Equation (2) is the rule for domestic credit creation. The

\(^4\)We assume that the production of the exogenous level of the main export commodity requires a fixed amount of labor \(L_c\). Denoting the labor force in the non tradables sector \(L_n\), \(L_c + L_n\) is the employment level.
percentage change in domestic credit is assumed to be equal to the percentage change in net foreign assets since the balance of payments determines money in the absence of sterilization. In theory, this relationship only holds for the Franc Zone as a whole since it corresponds to the monetary rules of the BCEAO and of the BEAC. The solvency rule for each of the two central banks states that the ratio of foreign reserves to all assets be limited from below or

\[ \frac{R}{R + Cr} \geq r_0 \]

Assuming the constraint to be binding, (i.e. the central bank issues as much credit as it can), \( R = r_0 (R + Cr) \) always holds and we have \( R \) proportional to \( Cr \), which is equation (2). In fact, some countries have obtained a proportionally greater share of credit while others had their allocation of central bank credit kept more in check. By including the zone-wide rule in a country specific model of inflation, we are imposing an additional restriction which in turn enables us to identify more clearly the relationship between fiscal policy response to changes in export commodity price and inflation.

Equation (3) comes from the log-differentiation of the equation defining nominal net foreign assets since
\[ E_t R_t = E_t R_{t-1} + E_t (Z_{1t} + Z_{2t}) + E_t (P^C_t C_t - P^M_t M_t) \]

where \( C_t \) represents exports of the primary commodity and \( M_t \) represents imports. We have:

\[ \rho = \frac{R_{t-1}}{R_t} , \quad \phi_1 = \frac{Z_{1t}}{R_t} , \quad \phi_2 = \frac{Z_{2t}}{R_t} , \quad \psi_1 = \frac{P^C_t C}{R_t} , \quad \psi_2 = \frac{P^M_t M}{R_t} \]

The fiscal side of the model is based on the description given in Chapter 3. As has been argued, receipts from commodity exports are the main source of government revenues in these countries. As \( P^C \) increases, the government starts spending (e.g., new projects, increases in public employment or in public sector wages). The longer the commodity boom lasts, the more difficult it will be for the government to reverse its spending pattern since it faces policy reversal costs (which increase with the length of the commodity boom) such as disinvestment costs for ongoing projects and firing costs for the public sector labor force. Once there is a commodity bust, the government must decide whether or not to reverse its spending policy. If the policy reversal costs are high, the government will prefer to let the public debt buildup. Once the debt buildup costs exceed the policy reversal costs, the government will start reversing its spending policy.

This discussion suggests the following equation to characterize fiscal policy:
\[ G_t = \sum_{i} \gamma_i \hat{P}_{C_t}^i + \zeta \hat{G}_{t-1} \] (4)

The coefficients on \( P_{C_t} \) and its lagged values characterize the extent of the government response to changes in commodity prices while the coefficient on \( G_{t-1} \) characterizes the inertia in the government's spending pattern\(^5\).

The percentage change in government revenues is equal to:

\[ \hat{T}_t = \hat{E}_t + \mu (\hat{P}_{C_t}^C + \hat{P}_{C_t}^C + \hat{C}_t) + (1-\mu) (\hat{P}_{C_t}^M + \hat{P}_{M_t}^M + \hat{M}_t) \] (5)

Equation (5) comes from the definition of trade taxes

\[ T = E (\tau^C P^C + \tau^M P^M) \]

and we have

\[ \mu = \frac{\tau^C P_{t}^C C}{\tau^C P_{t}^C C + \tau^M P_{t}^M M} \]

The percentage change in export tax for the export commodity is given by:

\(^{5}\)Equation (4) does not differentiate between positive export commodity price shocks and negative export commodity price shocks. In practice, as has been argued in Chapter 3, the reluctance to reverse a spending pattern would be observed only for the transition from a commodity boom to a commodity bust while the government would immediately readjust its spending pattern if there is a commodity boom. However, the estimation period is such that we essentially have a period of increasing export commodity price followed by a period of decreasing export commodity price (i.e., no transition from a commodity bust to a commodity boom).
\[ \hat{t}_t^c = \hat{c} \hat{p}_t^c + \chi \hat{e}_t \] (6)

Equation (6) corresponds to the fixed producer price of the primary commodity export, so that all of the windfall gains from the price surge accrue to the government. From 
\[ EP^c(1-\tau^c) = P^c = \text{constant}, \] we obtain equation (6) with 
\[ \chi = \frac{\tau^c}{1-\tau^c} \]

\( \tau^m \) is assumed to be exogenous.

On the supply side, the production function for non-tradables is assumed to be of the form:

\[ N_t = A_t \min \{ f(k_t, L_N); \frac{M_t}{\beta} \} \]

where \( f \) is a function (e.g. Cobb-Douglas) of \( k_t \) and of the employment level \( L_N \). This assumes that a fixed amount of imported intermediate goods (\( \beta \) for each unit of non tradables) is necessary to the production process which otherwise uses domestic factors of production. Profit maximization can be written as:

\[ \max _{L_N, L} \left\{ (P_t - \beta P^N_t) f(k_t, L_N, L) - w_t L_N - r k_t \right\} \]
with the capital stock $k_t$ fixed in the short run. The price that matters for production is

$$P'_t = P_t^N - \beta P_t^M$$

and we have

$$P'_t = \lambda P_t^N + (1-\lambda) P_t^M$$

with

$$\lambda = \frac{P_N}{P_N - \beta P_M}$$

$\lambda$ is the share of value added in production. Percentage changes in the supply of non-tradables are a function of percentage changes in the price $P'$ and in the capital stock $k_t$ and therefore, we have:

$$\dot{N}_t = \text{function (}\dot{A}_t, \dot{k}_t, \dot{P}'_t)$$

We also have

$$\dot{k} = \dot{K} - \dot{P} = \frac{I}{K} - \dot{P}$$

where $I$ is investment and $K$ the nominal capital stock. $K_t$ is related to past investment (i.e., lagged once). Any positive contribution to savings, either from foreign sources ($Z_{2,t-1}$) or from domestic sources — essentially public sector savings (i.e., primary surplus $T_{t-1} - G_{t-1}$) — contributes to capital formation. Incorporating the identity between savings and investment gives us the following equation:
\[ \hat{N}_t = \hat{A}_t + v \left( \frac{Z_{z,t-1}}{K_t} \right) + v \left( \frac{T_{t-1} - G_{1,t-1}}{K_t} \right) - v' \hat{P}_t + v' \hat{P}_t' \]

and finally,

\[ \hat{N}_t = \hat{A}_t + v \left( \frac{Z_{z,t-1}}{K_t} \right) + v \left( \frac{T_{t-1} - G_{1,t-1}}{K_t} \right) - v' \hat{P}_t + v' \lambda \hat{P}_t^N + v'(1-\lambda) \hat{P}_t^M \quad (7) \]

\( v \) is the supply elasticity of capital for the production of non tradables and \( v' \) is the price elasticity of supply. Note that the coefficients for \( Z_{z,t-1}/K_t \) and for \( (T_{t-1} - G_{1,t-1})/K_t \) are equal since we do not differentiate among sources of savings when looking at capital formation.

On the demand side, we assume fixed spending shares of imports and non tradables. We have

\[ v H_t = P_t^N N_t + P_t^M M_t \]

where \( v \) designates the constant velocity of money and we have substituted for absorption \( HV \), using the quantity theory equation. Let \( \alpha \) designate the fixed spending share on imports. Then,

\[ \alpha H_t = P_t^M M_t, \quad (1-\alpha) H_t = P_t^N N_t \]
Therefore, we have

\[ \hat{N}_t = \hat{H}_t - \hat{F}_t^M \]  

(8)

\[ \hat{N}_t = \hat{H}_t - \hat{F}_t^N \]  

(9)

We assume the quantity of commodity exports to be exogenously determined.

The domestic price level and the domestic price of imports are defined by

\[ P_t = (P_t^M)^\alpha (P_t^U)^{1-\alpha} \]

\[ P_t^M = E_t (1 + \tau_t^M) P_{t}^{M^*} \]

Exports, other than the primary commodity for which domestic consumption is marginal, are excluded. Log-differentiating the equations above, we finally have

\[ \dot{P}_t = \alpha \dot{P}_t^M + (1-\alpha) \dot{P}_t^N \]

(10)

\[ \dot{P}_t^M = \dot{P}_t + \omega \dot{\tau}_t^M + \dot{P}_{t}^{M^*} \]

(11)

with

\[ \omega = \frac{1 + \tau_t^M}{\tau_t^M} \]
Estimating the Model

In what follows, we ignore changes in productivity. Combining equations (1), (2) (3) with equations (8) and (11), we can see that the growth rate of money at time t can be expressed as a function of the growth rate of money at time t-1 and of the percentage changes of exogenous variables at time t.

We obtain the following equation for the monetary side of the model:

$$\hat{H}_t = \left[ \frac{1}{1+\Psi_2} \right] (\rho \hat{H}_{t-1} + \Phi_1 \hat{\xi}_1 + \Phi_2 \hat{\xi}_2 + \Psi_1 \hat{E}_t^{C^*} + \Psi_2 \hat{E}_t + \Psi_2 \omega \hat{t}_t) \quad (I)$$

Equation (4), the first equation of the fiscal side of the model, is repeated here for convenience. It expresses the percentage change in government expenditure at time t as a function of the percentage change in government expenditure as of time t-1 and of the percentage change at time t (including lagged values) of the international price of the main export commodity.

$$\hat{G}_t = \Sigma \gamma_i \hat{E}_t^{C^*} + \zeta \hat{G}_{t-1} \quad (II)$$

Combining equations (5) and (6) with equations (8) and (11), we obtain the second equation of the fiscal side of the model:
\[ \hat{\tau}_t = \mu (1+\chi) \hat{E}_t + \mu (1+\chi) \hat{P}_t^{C*} + (1-\mu) (1-\omega) \hat{\xi}_t^N + (1-\mu) \hat{H}_t \]  

(III)

This equation shows that the percentage change in government revenues is a function of the percentage change in exogenous variables at time t and of the growth rate money at time t.

Combining equations (9), (7) and (10), we obtain an equation for the percentage change in the price of non-tradables:

\[ \hat{P}_t^N = \left[ \frac{1}{1+v'\lambda-v(1-\alpha)} \right] (\hat{H}_t - v \frac{I_{t-1}}{K_t} + (v\alpha-v'(1-\lambda)) \hat{P}_t^M) \]

This equation corresponds to the reduced form for the price of non-tradables which clears the market.

Combining the above equation above with the price equations (10) and (11), we obtain the inflation equation of the model:

\[ \hat{P}_t = \left[ \frac{1-\alpha}{1+v'\lambda-v(1-\alpha)} \right] (\hat{H}_t - v \frac{I_{t-1}}{K_t} + F_1 (\hat{E}_t, \hat{\xi}_t^N, \hat{P}_t^M) \]  

(IV)

where the function \( F_1 \) is equal to:

\[ \left[ \alpha + \frac{(1-\alpha) (v\alpha-v'(1-\lambda))}{1+v'\lambda-v(1-\alpha)} \right] (\hat{E}_t + \omega \hat{\xi}_t^M + \hat{P}_t^M) \]
We now have defined a system of four equations. Equation (I) corresponds to the monetary side of the model; equations (II) and (III) correspond to the fiscal side; equation (IV) corresponds to the inflation side of the model.

This is a system of equation with 4 endogenous and 6 exogenous variables. A change in $P^e_t$ at time $t$ affects nominal money at time $t$ and government spending for a number of periods equal to the number of lags in equation (II). Government revenues are in turn affected for only one period at time $t$ by the change in $P^e_t$ and by the change in nominal money. Inflation is a function of the change in nominal money at time $t$ and of lagged investment, itself a function of lagged government revenues and government expenditures.

The equations above capture the link between the change in the international price of the main export commodity and the inflation rate. Since the Franc Zone countries are in a monetary union with a common currency pegged to the French franc, the only adjustment in the real exchange rate (ignoring changes in import taxes) is through the domestic price level.

The difference in the adjustment experience of the CFA countries is naturally related to the choices of fiscal and monetary policies. The countries share a common central bank and the overall money supply is largely an exogenous variable. However, the distribution of the money supply, within the union, is
left to the discretion of the central bank and is related to the fiscal policy adopted by each member country. Thus, the key behavioral difference between the member countries is their fiscal policy and more precisely the government's response to the fluctuations in the international price of its main commodity export. For this reason, the model was specified with the same monetary rule for all the countries. In theory, as seen earlier, this monetary rule is only valid for the zone as a whole.

Whether in a commodity boom or bust, it is the fiscal side that governs the macroeconomics since the price of non-tradables \( P^N \), the only variable that can freely adjust in the Franc Zone countries, is affected by government's demand for non-tradables which in turn is a function of the fiscal response to the fluctuations in the international price of the main export commodity.

The essence of the model is that the behavioral differences in fiscal policy between the CFA countries are reflected in differences in inflation rate between these countries.
4.4 Estimation and Simulation Results

In this section we test empirically the model of inflation differentials by estimating it for one country, Côte d'Ivoire, and by conducting a simulation with the estimated parameters.

Estimation Results

A variant of the model of inflation differential is tested for Côte d'Ivoire.

The data used for Côte d'Ivoire came from various sources, International Financial Statistics (IMF), African Economic and Financial Data (World Bank), and World Bank country reports. Variables for which we had several data sources were systematically checked for consistency. Excluding missing observations, the final data consists of yearly observations from 1970 until 1987. Three variables had to be constructed, capital \( K \), an index of commodity export price \( PCOM \) and government revenues \( T \).

The capital variable is needed since it appears in equation (IV). Relying on investment data, a time series for \( K \) was constructed starting in 1960\(^6\) using an initial capital output ratio

\[
K_t = K_{t-1} (1-\delta) + I_t \text{ with } K_{60} = 5 Y_{60}.
\]

Although estimation starts at 1970, we started the series in 1960 so that our final result would be less sensitive to the selected value for the initial capital output ratio. Several values of \( \delta \) were tried (3%, 5% and 7%) but did not

\[ \text{86} \]
of 5 and a depreciation rate of 5 percent\(^7\).

The two main export commodities for Côte d'Ivoire are coffee and cocoa. PCOM is constructed as a weighted sum of the international price of coffee and of cocoa (whose movements are incidentally strongly positively correlated), the weights being the quantity shares \(Q_{\text{cocoa}}/Q_{\text{cocoa}} + Q_{\text{coffee}}\) and \(Q_{\text{coffee}}/Q_{\text{cocoa}} + Q_{\text{coffee}}\).\(^8\) The quantity shares were obtained from African Economic and Financial Data.

Data on government revenues were constructed using data on government (current) expenditures and on the government's (primary) deficit available from World Bank documents.

Difficulty in obtaining reliable information on government expenditure and revenues prevented us from testing the model for a country other than Côte d'Ivoire. As one of the more advanced diversified coastal countries, Côte d'Ivoire's experience may deviate from that of a poorer, undiversified, landlocked country like Niger.

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\(^7\)As mentioned in Chapter 3, Taylor, (1979) suggests as a rule of thumb a depreciation rate of 4% and a capital output ratio of 3. Since he was referring to developing countries as a whole, we use slightly higher figures for African countries.

\(^8\)We use the fact that export revenues \(PQ\) are equal to \(P_1Q_1\) plus \(P_2Q_2\) which implies that

\[
P = P_1 \left( Q_1/(Q_1 + Q_2) \right) + P_2 \left( Q_2/(Q_1 + Q_2) \right)
\]
The modifications made to the original system given by equations (I) through (IV) are explained below.

First, it is assumed that there are no changes in the tax rate \( \tau^M \)\(^9\) and equations (I), (III) and (IV) are modified accordingly by removing the corresponding terms.

Second, in equation (IV), the percentage change in nominal money at time \( t \) has been replaced by its lagged value one period since equation (IV) gave a better fit when the variable was replaced by its one-period lagged value. The percentage change in money in equation (IV) comes from the log-differentiation of the demand side equations. These equations, in turn, are based on fixed spending shares and on the quantity theory of money. Therefore, specifying that total spending (between time \( t-1 \) and time \( t \)) on non-tradables \( P^M_t N_t \) is equal to \( (1-\alpha) VH_t \) or to \( (1-\alpha) VH_{t-1} \) are equal approximations, since what is really required under our assumptions is an average of the money stock over the period between \( t-1 \) and \( t \).

Finally since investment data are available, equation (IV), can also (instead of computing investment as in equation (7)), be estimated using directly the investment figures. In that case, an equation defining government revenues is no longer necessary and

\(^9\)Data was unavailable for \( \tau^M \).
equation (III) can be deleted from the system\textsuperscript{10}.

In sum, the system of equation which is estimated is the following:

\[ \hat{H}_t = \left[ \frac{1}{1 + \Psi_2} \right] (\rho \hat{H}_{t-1} + \Phi_1 \hat{Z}_{1t} + \Phi_2 \hat{Z}_{2t} + \Psi_1 \hat{C}^{c*} + + \Psi_2 \hat{E}_t) \]  

(\text{I})

\[ \hat{G}_t = \sum_{i=0}^{t-2} \gamma_i \hat{C}^{c*}_{t-1} + \zeta \hat{G}_{t-1} \]  

(\text{II})

or

\[ \hat{G}_{2,t} = \sum_{i=0}^{t-2} \gamma_i \hat{C}^{c*}_{t-1} + \zeta \hat{G}_{2,t-1} \]  

(\text{II'})

which is the same equation as above except that government expenditures \( G \) are replaced by government capital expenditures \( G_{2} \),

\[ \hat{C}^{*} = \left[ \frac{1 - \alpha}{1 + \nu' \lambda - \nu (1 - \alpha)} \right] (\hat{H}_{t-1} - \nu \frac{I_{t-1}}{K_{t}}) + F_1 (\hat{C}^{c*}, \hat{C}^{M*}) \]  

(\text{IV})

with \( F_1 \) equal to

\[ \left[ \alpha + \frac{(1 - \alpha) (\nu - \nu' (1 - \lambda))}{1 + \nu' \lambda - \nu (1 - \alpha)} \right] (\hat{C}^{c*} + \hat{C}^{M*}) \]

The results obtained from the estimation by three-stage least

\textsuperscript{10}Note that in both cases, keeping or deleting the equation from the system did not (as we would expect under the assumption that (III) is well-specified) modify in any significant way the coefficients from the remaining equations.
squares are shown in Table 4.4 and in Table 4.4'. The results correspond to a final estimation for which insignificant variables that did not contribute to a better fit were deleted. In Table 4.4', the fiscal relationship is estimated with $G_2$ instead of $G$ (i.e. equation (II') instead of (II)). In both cases, there is only (in addition to the current term) one lagged term (in addition to the current term) for the percentage change in the index price of export commodities.

The results confirm the hypothesis that fiscal policy is driven by fluctuations in the price of the main export commodity. The coefficient corresponding to percentage change (lagged once) in PCOM is significant. Without a lag, the percentage change in PCOM was found insignificant and this whether or not the variable lagged once is also in the equation. A two-period lag structure did not improve the results and showed the percentage change in PCOM lagged twice to be insignificant (at least when the same variable lagged only once was also present in the equation). Estimation with $G_2$ instead of $G$ gave similar results in terms of fit and significance (i.e., the one period lagged change in PCOM is significant while it is not without a lag or with a two period lag). Furthermore, the change in government expenditure lagged once is no longer significant. The fact that lagged percentage change in $G_2$ is no longer significant reinforces strongly our hypothesis since usually a one-period lagged value of the independent variable is expected to be significant (unless there is lack of correlation between
policy orientation between one time period and the next). The significance of the lagged percentage change of $G$ (which is equal to $G_1$ plus $G_2$) is explained by the fact that $G_1$ (government consumption) responds much less to change in the price of the export commodity than $G_2$ (government investment) so that $G$ and its one period lagged value are more correlated than $G_2$ and its one period lagged value. Therefore, the imputed fiscal response to fluctuations in export commodity prices is explained mostly by the public sector investment response.

The results show that both lagged money growth and current percentage change in PCOM are significant in the money growth equation. The other variables which appear in equation (I) were all insignificant. The results indicate that changes in commodity export prices can have (through the unsterilized accumulation of foreign reserves) important effects on the money supply.

The results for the inflation equation show that investment, an indicator of fiscal policy, is significant. Other variables and in particular, the percentage changes in the exchange rate (in dollars per CFA) and in the international price of imports, are not significant.

Although money creation (lagged once) is insignificant, it

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11Note that we are not talking about $G_2$ in level (i.e. the policy variable itself) but about the percentage change in $G_2$ (i.e. the policy orientation from one period to the next).
becomes significant (whether or not it is lagged), regardless of whether one uses $G$ or $G_2$ in the fiscal relationship, if the inflation equation is estimated with investment proxied by $Z_2 + T - G_1$ (as is done in the original model, see equation (7)). However, it is again insignificant if investment is proxied by $G_2$ alone. The conditions under which different proxies can be used for investment are outlined in what follows.

Using the savings equal investment identity and a decomposition of investment by sources and of savings by sources, it can be shown that using the primary surplus $G_1 - T$ plus $Z_2$ as a proxy for investment is a valid assumption if private saving is close to zero. Using $G_2$ as a proxy for investment is a valid assumption if private saving is essentially equal to government private borrowing and if foreign borrowing by the private sector is close to zero. It can also be shown that using $G_2$ plus $Z_2$ (where $Z_2$ is the nominal capital account) as a proxy for investment is a valid assumption if again private saving is essentially equal to government private borrowing and if foreign borrowing by the public sector is close to zero. All these assumptions are not necessarily in contradiction with each other. For example, whether public or private foreign borrowing can be assumed to be close to zero, depends upon whether public enterprises are considered to be in the public or in the private sector.

To summarize, the results conform well to the predictions of
our model and are consistent with our explanation of inflation in a typical CFA country. They highlight the great dependence of the economy of Côte d'Ivoire on its two export commodities: coffee and cocoa.

*Simulation Results*

The results above have shown that changes in commodity export prices have important effects on the domestic price level (and hence, given the fixed exchange rate, on the real exchange rate). The purpose of the simulation exercise is to analyze the response of a typical CFA economy (or more generally a typical primary commodity exporter with a fixed exchange rate) to exogenous changes in the international price of its main export commodity.

To emphasize the most important behavioral aspects of our inflation model, we modify slightly the original model.

The simulation scenario is that of a commodity boom followed by a commodity bust. The international price of the main export commodity is the only exogenous variable allowed to vary in the simulation and all the other exogenous variables of the model are assumed to be constant. The simulation scenario does not correspond exactly to the actual behavior of the price of coffee (or that of cocoa) since there were two coffee (and cocoa) booms. Figure 4.5 shows the simulation scenario while Figure 4.6 shows the
actual behavior of PCOM for Côte d'Ivoire.

As can be seen in Figures 4.7 and 4.8, the behavior of investment and of public capital expenditures is similar for Côte d'Ivoire\(^{12}\). Thus, equation (IV) is modified with investment proxied by public capital expenditures \(G_2\). To be consistent, \(G_2\) is also used in the fiscal equation (i.e equation (II')) instead of (II)). Using \(G_2\) in the inflation equation (instead of investment) simplifies the simulation and emphasizes the key behavioral aspects of the economy reviewed above. Without \(G_2\), an additional equation relating investment to fiscal policy would be needed as well as a specification of private and direct foreign investment (the latter can probably be considered as exogenous).

Thus, the simulation model is the following:

\[
\begin{align*}
\hat{H}_t &= \left[ \frac{1}{1+\psi_2} \right] (\rho \hat{H}_{t-1} + \psi_1 \hat{F}_t^{C*}) \\
G_{2,t} &= \sum_{i=0}^{i-2} \gamma_i \hat{F}_{t-i}^{c*} + \zeta \hat{G}_{2,t-1}
\end{align*}
\]

\(^{12}\)The scales of the figures are different. Thus, public investment appears to be a (constant) fraction of total investment. This would suggest that the behavior of the private sector, as far as investment goes, is similar to the public sector's behavioral response to fluctuations in the price of the main export commodity.
\[ \hat{p}_t = \left[ \frac{1-\alpha}{1+\nu'\lambda - \nu(1-\alpha)} \right] (\hat{p}_{t-1} - \nu \frac{G_{2,t-1}}{K_t}). \]

Note that the first two equations can be estimated (or simulated) independently since no other endogenous variable except the independent variable is included. This reflects the fact that a change in the price of the export commodity has, as has been explained earlier, a fiscal and a monetary effect (i.e., the first two equations of the simulation) which in turn translate into inflation.

Again it should be emphasized that the key behavioral equation of the model is the specification of fiscal policy. The remaining equations are essentially accounting identities which are written in the context of a primary commodity exporter in a fixed exchange rate regime. To stress this point, the simulation uses only the estimated parameters for the fiscal equation while all parameters for the other equations are assigned "realistic" values independently. The values and the rationale for selecting them are given below.

In the monetary relationship the parameters selected are \( \psi_1 = \psi_2 = 2 \) and \( \rho = 0.95 \). Since \( \psi_1 (\psi_2) \) is the ratio of exports (imports) to reserves, the underlying assumptions are balanced trade (at least in the long run) and that the central bank has enough reserves to cover six months of imports. A decrease in reserves would increase \( \psi_1 \) and \( \psi_2 \). \( \rho \) is simply the ratio of
reserves from one period to the next.

In the inflation relationship, the parameters selected are \( \alpha \) (share of imports including intermediate inputs in the consumption basket) = 0.25; \( \nu \) (supply elasticity of capital for the non traded good) = 3; \( \nu' \) (supply price elasticity for the non tradable good) = 0.4 and \( \lambda \) (value added in production\(^{13} \)) = 1.333.

Finally, in the fiscal relationship, the parameters used are the estimated values of a fiscal equation (with \( G_2 \) as in (II')) which is part of a model for which \( G_2 \) is used as a proxy for investment in the inflation equation. The parameters are \( \zeta = 0.198 \), \( \gamma_0 = 0.227 \) and \( \gamma_1 = 0.556 \).

Figure 4.9 shows the predicted public investment. It corresponds to a simulation of the estimated fiscal equation and replicates the "hump" in public capital expenditures associated with a commodity boom followed by a commodity bust.

Figures 4.10 and 4.11 show actual and predicted inflation in Côte d'Ivoire. The simulation shows the increase in inflation during the commodity boom followed by a decrease during the commodity bust and a stabilization (with a minor increase) once commodity prices stabilize again. The predicted behavior is again

\(^{13}\)It was shown earlier that \( \lambda \) is equal to \( P_W / (P_W - \beta P_W) \). With \( P_W = 1 \) (numeraire) and \( \beta = 1/4 \) (i.e. 0.25 unit of import needed for the production of each unit of domestic good), we get \( \lambda = 4/3 \) or 1.333.
consistent with the data. The differences in levels in the later periods may be attributed to the fact that the simulation scenario does not correspond to the exact values of the exogenous variables in Côte d'Ivoire.

To summarize, the simulation performs well and could be used for other CFA countries (or more generally countries whose economic structure is similar). Naturally, for the simulation to be more than the tool we use here to enhance the explanation of our model, it would be necessary to have forecasts of export commodity prices\textsuperscript{14} (although the simulation can be used as a predictive measure of real exchange rate behavior under different scenarios) and to know the fiscal parameters of a particular country. To get these parameters, one needs only to estimate the fiscal equation since it is independent from the rest of the system. It is also possible to use the simulation under different hypothetical fiscal responses. However, such an exercise is not meaningful since a plausible range for the magnitude of the fiscal equation parameters is not known. To obtain these, it would be necessary to estimate the fiscal equation for other CFA countries\textsuperscript{15}.

\textsuperscript{14}although the simulation can be used as a predictive measure of real exchange rate behavior under different scenarios

\textsuperscript{15}Data on government expenditures (general and on capital) is unfortunately very unreliable and often inexistant altogether.
4.5 Conclusions

It was first shown that, despite the monetary union and other extensive ties with France, a fixed exchange rate and substantial intra-zonal labor mobility, there are, at least in the short run, substantial inflation differentials across the countries of the CFA Zone.

Then, we proposed a model of inflation differentials for the CFA Zone. The model is based on the fact that for primary exporters in general, and CFA Zone members in particular, the volatility in commodity prices implies a high variance of government revenues. The model identifies two effects: a monetary effect (commodity booms imply a surge in foreign reserves which, if unsterilized, is inflationary) and a fiscal effect (higher government revenues are, to varying degrees, accompanied by a marked increase in the level of public spending which again is inflationary). Although some countries get a proportionally greater share of the pooled reserves, our model ignores this\textsuperscript{16} (by imposing on each country a constraint on the level of reserves which in fact is only valid for the Zone as a whole) and attributes the differences in inflation across countries to the fiscal response. The fiscal relationship is the key behavioral equation of the model since the other relationships are essentially derived from accounting identities which are valid given the economic

\textsuperscript{16}The rationale for doing this is explained in Section 4.3.
structure of the countries (i.e., fixed exchange rate and impossibility to sterilize due to absence of a money market).

The model is empirically tested for Côte d'Ivoire. The results show the key parameters to be statistically significant. The model is also simulated. The simulation exercise requires estimated coefficients from the fiscal relationship only since all the other parameters are selected independently. Therefore, once the fiscal behavioral response is known, the simulation provides a tool to analyze real exchange rate response under different scenarios of fluctuations in export commodity prices. The simulation exercise shows that the path of inflation in Côte d'Ivoire can, indeed, be tracked by a model like ours.
Table 4.1

Average Annual Inflation

<table>
<thead>
<tr>
<th></th>
<th>1973-81</th>
<th>1982-89</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFA</td>
<td>12.0</td>
<td>4.3</td>
</tr>
<tr>
<td>Other Sub-Saharan African</td>
<td>24.3</td>
<td>29.7</td>
</tr>
<tr>
<td>Low-Income LDC's</td>
<td>18.4</td>
<td>33.7</td>
</tr>
<tr>
<td>Primary Producers LDC's</td>
<td>24.4</td>
<td>44.9</td>
</tr>
</tbody>
</table>

Note: Unweighted Averages
Table 4.2

Inflation within the CFA Zone

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Burkina</td>
<td>8.4</td>
<td>4.9</td>
<td>6.9</td>
<td>-2.6</td>
<td>-2.6</td>
</tr>
<tr>
<td>Côte d'Ivoire</td>
<td>5.9</td>
<td>4.3</td>
<td>1.9</td>
<td>6.6</td>
<td>5.3</td>
</tr>
<tr>
<td>Mali</td>
<td>9.8</td>
<td>12.4</td>
<td>7.8</td>
<td>-3.9</td>
<td>-16.7</td>
</tr>
<tr>
<td>Niger</td>
<td>2.5</td>
<td>8.5</td>
<td>-1.0</td>
<td>-3.2</td>
<td>-6.8</td>
</tr>
<tr>
<td>Senegal</td>
<td>11.7</td>
<td>11.8</td>
<td>13.0</td>
<td>6.0</td>
<td>-4.3</td>
</tr>
<tr>
<td>Togo</td>
<td>8.2</td>
<td>-3.5</td>
<td>-1.8</td>
<td>3.2</td>
<td>-0.6</td>
</tr>
</tbody>
</table>

Source: Direction de la Statistique des Etats de la Banque de France
<table>
<thead>
<tr>
<th>Table 4.3</th>
<th>Cointegration Tests Results</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cointegration Tests Results for Price Levels</strong></td>
<td><em>(Augmented Dickey Fuller Statistic, 2 lags)</em></td>
</tr>
<tr>
<td><strong>France and major country of each zone</strong></td>
<td></td>
</tr>
<tr>
<td>Côte d'Ivoire / France</td>
<td>Yes</td>
</tr>
<tr>
<td>Cameroon / France</td>
<td>No</td>
</tr>
<tr>
<td><strong>Major country of each zone</strong></td>
<td></td>
</tr>
<tr>
<td>Côte d'Ivoire / Cameroon</td>
<td>No</td>
</tr>
<tr>
<td><strong>BCEAO countries</strong></td>
<td></td>
</tr>
<tr>
<td>Niger / Côte d'Ivoire</td>
<td>No</td>
</tr>
<tr>
<td>Senegal / Côte d'Ivoire</td>
<td>Yes</td>
</tr>
<tr>
<td>Togo / Côte d'Ivoire</td>
<td>No</td>
</tr>
<tr>
<td><strong>BEAC countries</strong></td>
<td></td>
</tr>
<tr>
<td>Gabon / Cameroon</td>
<td>No</td>
</tr>
<tr>
<td>Congo / Cameroon</td>
<td>No</td>
</tr>
</tbody>
</table>
Table 4.4
Estimation Results (3SLS)

Equation 1 Fiscal Relationship

<table>
<thead>
<tr>
<th>Dependent Variable HG</th>
<th>coefficient</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>HG_1</td>
<td>.528</td>
<td>3.71</td>
</tr>
<tr>
<td>HPCOM</td>
<td>.072</td>
<td>.65</td>
</tr>
<tr>
<td>HPCOM_1</td>
<td>.233</td>
<td>2.11</td>
</tr>
<tr>
<td>RBAR**2</td>
<td>.278</td>
<td></td>
</tr>
</tbody>
</table>

Equation 2 Monetary Relationship

<table>
<thead>
<tr>
<th>Dependent Variable HH</th>
<th>coefficient</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>HH_1</td>
<td>.678</td>
<td>5.32</td>
</tr>
<tr>
<td>HPCOM</td>
<td>.281</td>
<td>3.14</td>
</tr>
<tr>
<td>RBAR**2</td>
<td>.216</td>
<td></td>
</tr>
</tbody>
</table>

Equation 3 Inflation

<table>
<thead>
<tr>
<th>Dependent Variable KP</th>
<th>coefficient</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>HH_1</td>
<td>.114</td>
<td>.95</td>
</tr>
<tr>
<td>100* I_1/K</td>
<td>1.09</td>
<td>3.50</td>
</tr>
<tr>
<td>RBAR**2</td>
<td>.188</td>
<td></td>
</tr>
</tbody>
</table>

1 indicates a one period lag. Any variable whose label starts with an H (hat) is in percentage change. G is government expenditures, H is money, P the price level, PCOM the export commodity price index, I is investment and K capital.
Table 4.4'  
Estimation Results (3SLS)

Equation 1 Fiscal Relationship

<table>
<thead>
<tr>
<th>Dependent Variable HG2</th>
<th>17 Observations from 1971:1 until 1987:1</th>
<th>coefficient</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>HG2_1</td>
<td>.233</td>
<td>1.16</td>
<td></td>
</tr>
<tr>
<td>HPCOM</td>
<td>.251</td>
<td>1.14</td>
<td></td>
</tr>
<tr>
<td>HPCOM_1</td>
<td>.541</td>
<td>2.50</td>
<td></td>
</tr>
<tr>
<td>RBAR**2</td>
<td>.20</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Equation 2 Monetary Relationship

<table>
<thead>
<tr>
<th>Dependent Variable HH</th>
<th>17 Observations from 1971:1 until 1987:1</th>
<th>coefficient</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>HH_1</td>
<td>.671</td>
<td>5.53</td>
<td></td>
</tr>
<tr>
<td>HPCOM</td>
<td>.282</td>
<td>3.15</td>
<td></td>
</tr>
<tr>
<td>RBAR**2</td>
<td>.218</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Equation 3 Inflation

<table>
<thead>
<tr>
<th>Dependent Variable HP</th>
<th>17 Observations from 1971:1 until 1987:1</th>
<th>coefficient</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>HH_1</td>
<td>.120</td>
<td>1.02</td>
<td></td>
</tr>
<tr>
<td>100* I_1/K</td>
<td>1.09</td>
<td>3.48</td>
<td></td>
</tr>
<tr>
<td>RBAR**2</td>
<td>.189</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The notation is identical to that of Table 4.3. G2 is public capital expenditures.
Figure 4.1
Inflation Rates: Core Countries

Figure 4.2
Inflation Rates: BCEAO Coastal Countries
Figure 4.3
Inflation Rates: BCEAO Landlocked Countries

Figure 4.4
Inflation Rates: BEAC Countries
Figure 4.5
Simulated Export Commodity Price

Figure 4.6
Côte d'Ivoire: Foreign Price of Export Commodity
Figure 4.7
Côte d'Ivoire: Investment

Figure 4.8
Côte d'Ivoire: Government Investment Expenditure
Figure 4.9
Simulation Results for Government Investment Spending

Govt. Inv. Spending

0  2  4  6  8  10  12  14  16  18  20
periods

0.4  0.5  0.6  0.7  0.8  0.9  1.0  1.1
Figure 4.10
Côte d'Ivoire: Inflation

Figure 4.11
Simulation Results for Inflation
CHAPTER 5

INSTITUTIONAL ARRANGEMENTS' FLEXIBILITY AND ADJUSTMENT TO EXTERNAL SHOCKS

5.1 Introduction

Macroeconomic instability is often thought to be one of the major impediment to growth in developing countries. This chapter aims at evaluating whether the institutional arrangements of the CFA Zone which emphasize fiscal and monetary discipline can sometimes lead to inadequate adjustment strategies. More precisely, we ask how the nature and magnitude of shocks influence the desirability of one balance of payment adjustment mechanism over the other. The chapter is motivated by the need to understand the factors behind the economic slowdown of the African countries which are members of one of the two monetary unions which constitute the CFA Zone.

As documented in Devarajan and De Melo (1990), for the CFA countries, the 1980's have been a decade of an apparent lack of

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1I would like to acknowledge helpful discussions with Shantayanan Devarajan who was working on the same set of issues at the time. All remaining errors are mine.
adjustment to the changed external environment inherited from the 1970's. Earlier, membership in the zone was viewed as beneficial since it was expected that guaranteed convertibility of the CFA franc and fixed exchange rate would lead to a stable environment which would stimulate foreign investment and growth. (See, for example, Guillaumont and Guillaumont (1988), Devarajan and De Melo (1987a).) The impossibility to use an inflation tax would enable the countries to avoid some of the common excesses of other developing countries. Furthermore, the lack of currency devaluation as an adjustment mechanism was not thought to be a major obstacle since, as pointed out by Devarajan and De Melo (1987b), there were other instruments available to depreciate the real exchange rate.

However, Devarajan and De Melo (1990) argue that in the latter part of the decade, the CFA countries relied on expenditure reduction and in particular investment reduction to improve their current accounts while neighboring countries, through currency depreciation, relied much more on expenditure switching. Devarajan and De Melo also show that, given the nature and magnitude of the external shocks, the need for adjustment was comparatively less in the CFA Zone. However, in spite of this, they still conclude\(^2\) that "Controlling for differences in shocks they faced, the amount of current account improvement in the CFA Zone was systematically

---

\(^2\)Devarajan and De Melo use a modified control-group approach (see, Faini et al, 1990) to control for changes in the external environment when analyzing performances of CFA and other Sub Sahara African countries.
lower than in the comparator groups." "CFA countries are conspicuous by their inability to reduce their current account deficits, even taking into account that the shocks they faced may have been different."

One interpretation of the poor performance of the CFA countries is that the institutional arrangements which allowed them higher and more stable growth in the 1970's are now preventing them from adjusting appropriately to the shocks of the 1980's. This situation is similar to the one described by Eichengreen and Sachs (1985) who show that countries that went off the Gold Standard early (by depreciating their currency) were able to adjust better to the external shocks of the 1930's. Again, we have institutional arrangements which appeared to have been adequate at times of economic stability but which proved to be inadequate when the economy was subject to certain shocks.

5.2 Model of Output Determination

The purpose of this model is to evaluate output and price responses to various shocks under different macroeconomic policies. More precisely, we compare the behavior of an economy for which the instrument of adjustment of the balance of payments is fiscal policy (i.e. a reduction in government capital expenditure decreases the need for foreign financing and therefore improves the current account) with an economy for which the instrument of
adjustment is the nominal exchange rate.

The source of rigidity in the economy is wage stickiness reflected in the existence of contracts. The framework employed is a standard small country open economy model with rational expectations. Similar models have been used to analyze the effects of disturbances on an economy under different policy settings (e.g., money and/or exchange rate rules) and/or under different institutions (e.g., wage indexation). See, for example, Fischer (1986, 1988 and 1990) and Turnovsky (1976 and 1983).

The model is specified to incorporate key features of the African economies of interest, in particular their dependence on commodities exports and the institutional arrangements of the monetary unions which imply that the budget deficit cannot be financed by an inflation tax and that foreign reserves are not sterilized. As a result, the change in money supply is determined by the change in foreign reserves. This aspect is similar to the structural model for a typical CFA country described in Chapter 4.

All variables, except for the interest rates, are in logarithms. There are three goods:

i) main export commodity export whose exogenous export price in dollars is given by \( P_t^e \);

ii) imports whose exogenous dollar price is given by \( P_t^m \); and
iii) non tradables whose price in domestic currency is $Q_t$.

Domestic residents consume imports and non tradable while commodity exports are entirely sold abroad. Therefore, the domestic price level $P_t$ is given by:

$$P_t = \alpha Q_t + (1-\alpha)(P_t^{m*}+E_t)$$ \hspace{1cm} (1)

where $E_t$ is the nominal exchange rate expressed in domestic currency per dollar.

There are two assets, domestic money which is non traded and a bond traded internationally with perfect capital mobility. Uncovered interest parity implies:

$$I_t = R_t + E(P_{t+1}|t)-P_t$$

$$I_t = I_t^* + E(E_{t+1}|t)-E_t$$ \hspace{1cm} (2)

where $I_t$ is the nominal interest rate, $R_t$ the real interest rate and $I_t^*$ the exogenous foreign nominal interest rate. $E(E_{t+1}|t)$ ($E(P_{t+1}|t)$) designates the expectation held at time $t$ of the nominal exchange rate (domestic price level) for time $t+1$.

The IS curve is defined by:
\[ Y_t^d = [1 - \nu'] [\delta'(E_t + P_t^* - Q_t) - \sigma'R_t^d] + \nu'F_t + u_{1t} \]  

where \( Y_t \) is real domestic output, \( F_t \) is public sector investment expenditures in real terms, and \( u_{1t} \) is a stochastic disturbance in the demand for domestic output. \( \nu' \) is equal to the share in aggregate demand of public sector investment expenditures (in level term) on domestic goods. We denote \((1-\nu')\delta'\) by \( \delta \) and \((1-\nu')\sigma'\) by \( \sigma \).

The IS curve can be derived as follows. In level form, aggregate demand for non tradables \( A^d \) is the sum of domestic good consumption \( C \) (private and public) and of the share \( \theta \) of investment \( I \) (which is assumed to come essentially from the public sector) on domestic goods. Assuming

\[ C = \left( \frac{EP^*}{Q} \right) \delta' R^{-\sigma'} \]

and log differentiating

\[ A^d = C + \theta I \]

we obtain equation (3) with

\[ \nu' = \frac{\theta I}{C + \theta I} \]
The LM curve is defined by:

\[ M_t - P_t = \phi(Y_t + Q_t - P_t) - \beta I_t + u_{2t} \]  \hspace{1cm} (4)

where \( M_t \) is the domestic nominal money supply and \( u_{2t} \) is a stochastic disturbance in the demand for domestic money.

On the supply side, we assume that aggregate supply of non traded goods is given by:

\[ Y^g_t = \gamma (Q_t - W_t) + u_{3t} \]  \hspace{1cm} (5)

where \( W_t \) is the nominal wage and \( u_{3t} \) is a stochastic disturbance in the supply of domestic output. \( Q_t - W_t \) is the real wage that matters for domestic firms. The supply of traded goods (primary agricultural commodity which has a long investment lag) is assumed to be independent of short term fluctuations in the domestic economy.

On the money supply side, we assume that the financial markets are not sufficiently developed to allow open market operations and therefore, that the monetary base \( H \) is determined exclusively by net foreign assets \( NFA \). Let \( CA \) designate the current account, we have:

\[ \Delta H - \Delta NFA = CA \]
A constant money multiplier $m$ is assumed so that percentage changes in the money base are always equal to percentage changes in the money supply.

There are three mechanisms for improving the balance of payments. First, an increase in the relative price $E_t P_t^{m*} - Q_t$, due, for example, to a nominal depreciation, will shift spending toward non tradable and thus, improve the current account. Second, an increase in the commodity export international price (assuming that foreign demand is inelastic) and/or a nominal depreciation will increase commodity export revenues measured in domestic currency. This also contributes to an improvement in the current account. Third, a reduction in imports for public investment expenditures ($F_t + Q_t$ in nominal terms) will improve the current account. Incorporating these three mechanisms and the above assumption on the determination of the money supply, we have:

$$M_t = \lambda_1 (E_t P_t^{m*} - Q_t) + \lambda_2 (E_t P_t^{c*}) - \nu (F_t + Q_t) \tag{6}$$

where $\lambda_1$ is the elasticity of the current account with respect to the real exchange rate, $\lambda_2$ is the elasticity of the current account with respect to the international price (in domestic currency) of the export commodity and $\nu$ is the elasticity of the current account with respect to public investment expenditures.

A general formulation for the nominal wage as of time $t$ is to
set it equal to a contracted wage for time t at time t-1 $W_{t,t-1}^c$ plus a term which corresponds to wage indexation. We assume that there is no wage indexation and that the wage contract is given simply by:

$$W_t = \bar{W}$$ (7)

where $W$ is an institutionally fixed nominal wage independently of expectations on indicators of economic performance. Under the assumption that shocks are serially uncorrelated, the contract structure is irrelevant to the dynamics of the model since we also have no serial correlation in the policy variables. With a predetermined wage, the shocks (in the absence of serial correlation) will not have persistent effects.

The three domestic stochastic variables, $u_{1t}$, $u_{2t}$, $u_{3t}$ are assumed to be independent with zeros means and finite variances. The foreign exogenous variables are assumed to be random and we assume:

$$I^* = \bar{I}^*_t + \epsilon_{1t}$$
$$P_t^m = \bar{P}_t^m + \epsilon_{2t}$$
$$P_t^c = \bar{P}_t^c + \epsilon_{3t}$$ (8)

where $\epsilon_{1t}, \epsilon_{2t}, \epsilon_{3t}$ are white noise disturbances.
5.3 Impact of Disturbances

The model has eight equations (excluding equation (8) which deals only with exogenous variables and counting equation (2) as two equations since it contains two interest rate relationships) and eight endogenous variables. The endogenous variables are $P_t$, $Q_t$, $R_t$, $I_t$, $Y_t$, $M_t$, $W_t$ and one of the two variables: $E_t$ or $F_t$. In the fixed exchange rate regime ($E_t = \text{constant}$), fiscal policy is the instrument. It adapts itself to the fixed exchange rate requirement. In the alternative regime, the exchange rate is the instrument and adapts itself to the requirement $F_t = \text{constant}$. In both cases, $E_t = \text{constant}$ ($F_t = \text{constant}$) are intervention rules (i.e. the economic strategy) and the variable not included in the intervention rule is endogenous. The method to solve the model is described in what follows.

We first reduce the dimensionality of the system by substituting the equations defining the price level, the interest rates and the wage in the other equations. This enables us to work with only four equations and four endogenous variables since $P_t$, $I_t$, $R_t$ and $W_t$ are eliminated. Second, we define an initial equilibrium (denoted by bars) by assuming that expectations are realized and setting all random variables at their means. Third, we subtract from each of the four equations, the corresponding equation defining the equilibrium to obtain a four equation system in the following variables:
\[ y_t = Y_t - Y; \]
\[ m_t = M_t - M; \]
\[ q_t = Q_t - Q; \] and
\[ e_t = E_t - E \text{ or } f_t = F_t - F. \]

Setting all expectations to zeros (the rational expectation solution since the model is written out in differences around an equilibrium), the corresponding system of equations is shown below.

\[ y_t = \delta(e_t - q_t) + \sigma(\varepsilon_t - q_t) + \nu'f_t + u_{1t} - \sigma\dot{e}_{1t} + (\delta - \sigma(1 - \alpha))e_{2t} \]
\[ m_t - q_t = \phi y_t - (1 - \alpha)(\varepsilon_t - q_t) + \beta e_t + u_{2t} - \beta\dot{e}_{1t} - (1 - \alpha)(\phi - 1)e_{2t} \]
\[ y_t = \gamma q_t + u_{3t} \]
\[ m_t = \lambda_1(e_t - q_t) + \lambda_2 e_t - \nu'(f_t + q_t) + \lambda_1 e_{2t} + \lambda_2 e_{3t} \]

This system can be readily solved for fluctuations in output \( y_t \) and in domestic price \( P_t \) for both regimes to yield expressions

\[ y_t = \text{function}(u_{1t}, u_{2t}, u_{3t}, \varepsilon_{1t}, \varepsilon_{2t}, \varepsilon_{3t}). \]

\[ P_t = \text{function}(u_{1t}, u_{2t}, u_{3t}, \varepsilon_{1t}, \varepsilon_{2t}, \varepsilon_{3t}). \]

Table 5.1 (5.1') shows the impact effect of unanticipated disturbances on real output (domestic price level) for a fixed exchange rate regime while Table 5.2 (5.2') shows the impact effect.
of unanticipated disturbances on real output (domestic price level) for a flexible exchange rate regime.

For ease of exposition, we assume that \( \phi \) is equal to 1 so that the LM curve is

\[
M_t - P_t = (Y_t + Q_t - P_t) - \beta I_T + u_{2t}
\]

In this case, \( \Omega \) (defined in Table 5.1) is unambiguously positive while the sign of \( \Omega' \) (defined in Table 5.2) remains uncertain. However, for reasonable values of the parameters, it is safe to assume that \( \Omega' \) is also positive.

For a fixed exchange rate, the signs of the terms in Table 5.1 (effect on real output) are positive for real demand, supply, interest rate, import price and export prices disturbances and indeterminate for a monetary disturbance. For Table 5.1' (effect on price level), the signs are positive for real demand, interest rate, import and export price disturbances, negative for a supply disturbance and indeterminate for a monetary disturbance.

For real demand, monetary, interest rate and export price disturbances, the magnitude of the effect on real output is \( \frac{\gamma}{\alpha} \) times the magnitude of the effect on the price level. Even for countries with a large share of imports in the consumption basket, a priori, \( \frac{\gamma}{\alpha} \) is larger than one and the above disturbances have a
greater effect on output than on the price level which is precisely what one would expect from a fixed exchange rate regime.

For a flexible exchange rate, the signs of the terms in Table 5.2 (effect on real output) are positive for real demand and monetary disturbances, negative for the interest rate disturbance, indeterminate for all the other disturbances, although a priori negative for the import and export price disturbances. For Table 5.2' (effect on price level), the signs are positive for the monetary disturbance, negative for the export price disturbance and indeterminate for all the other disturbances.

5.4 Welfare Comparison

The purpose of this section is to evaluate how the nature and the magnitude of shocks influence the optimality of one current account adjustment rule over the other. We limit ourselves to external shocks.

In order to be able to assess which of the two institutional arrangements is preferred by policy makers under certain shocks, it is necessary to introduce a welfare (or in this case a loss) function. Let $W$ defined by

$$W = \psi \rho^2 + y^2$$
designate the loss function.

Macro welfare functions like $W$ have played an important role in the literature. (See, for example, Blanchard and Fischer (1989)). The loss function is quadratic in deviations from equilibrium values of both output and price level. The term for output corresponds to the welfare loss of being away from the equilibrium value of output. The term for the price level corresponds to the welfare loss of instability in the price level.

In what follows, we consider two methods of welfare comparison, one for which the parameter $\psi$ is treated as an unknown and one for which it is treated as a known parameter.

$\psi$ unknown

Having defined $W$ as above, we could now proceed to construct time series for CFA countries of the difference

$$W_{\text{fix}} - W_{\text{flex}}$$

where $W_{\text{fix}}$ is $W$ evaluated for a fixed exchange rate regime and $W_{\text{flex}}$ is $W$ evaluated for a flexible exchange rate regime.

In order to evaluate $W$, we need the following information:

i) values of the parameters of the model;

ii) values for the variances of the different shocks; and

iii) value of the parameter $\psi$. 

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We can obtain plausible values of the parameters of the model by selecting the following base case:

For $\alpha$, the parameter of the price level definition equation we select 0.6 which corresponds to 40 percent of imports in the consumption basket.

For $\delta'$, $\sigma'$ and $v'$, the parameters of the IS curve, we select 0.2, 0.15 and 0.1 so that $\delta$ equals 0.18 and $\sigma$ equals 0.135. An order of magnitude for $v'$ can be obtained as follows. Assume that I is 25% of C and that 75% of investment is public investment with an import component of 0.4. Then, $v'$ is equal to $((1-0.4)*0.75*0.25)/(1+0.25(1-0.4))$ or 0.1.

For $\beta$, the remaining parameter of the LM curve, we select 0.25.

For $\gamma$, the parameter of the aggregate supply equation, we select 0.75.

All the parameters above, with the exception of $\alpha$ and of $v'$, are taken from Fischer (1986).

Finally, the parameters of the money supply equation $\lambda_1$, $\lambda_2$ and $v$ are given the following values 0.6, 0.8 and 0.3. An increase in the relative price $E_t + P^m_t - Q_t$ shifts spending toward non
tradable. However, the remaining imports require more foreign exchange expenditures and, therefore, the parameter $\lambda_1$ is set below 1 at 0.6. $\lambda_2$ is selected larger than $\lambda_1$, since if the price of commodities export $E_t + P^c_t$ goes up, assuming inelastic foreign demand, the quantity of commodities exports does not decrease. Finally, a decrease in public investment (because of the import component) leads to an increase in foreign reserves. The larger the import component of public investment expenditures, the larger $\psi$ is.

In order to compute the time series above, we need, as stated earlier, values for the variances of the different shocks. These can be obtained, at least if we limit ourselves to external shocks (interest rate, import price and export price shocks), from country specific time series data.

The country specific parameter $\psi$ corresponds to the relative weight placed by the authorities on price stability. It is such that one percentage point in deviation in price level is considered to be equivalent to $\psi$ percentage point in deviation in output. The greater $\psi$ is, the greater the importance attached to price stability. $\psi$ is difficult to obtain and instead of assigning a value to it, we can evaluate the difference $W_{\text{fix}} - W_{\text{flex}}$ treating $\psi$ as an unknown parameter. We can then obtain a time series for a lower bound for $\psi$ by selecting the parameter which solves $W_{\text{fix}} - W_{\text{flex}}$ equal zero.
\[ \psi \text{ defined above is such that} \]
\[ \psi = \frac{y_{t, \text{flex}}^2 - y_{t, \text{fix}}^2}{p_{t, \text{fix}}^2 - p_{t, \text{flex}}^2} \]

The parameter \( \psi \) as it is defined above should be positive since both the numerator and the denominator are expected to be negative. A priori, fluctuations in output should be less under a flexible exchange rate system (at least, for reasonable values of the parameters and of the variances of the shocks) since changes in the nominal exchange rate can be used to dampen output's fluctuations in response to external shocks. A priori, fluctuations in the price level should also be less under a fixed exchange rate system since pegging one's currency to a low inflation country's currency (i.e., France) provides an anchor for the economy which prevents the price level to fluctuate too much.

For any \( \psi' \) smaller than \( \psi \), we would have
\[ \psi' (p_{t, \text{fix}}^2 - p_{t, \text{flex}}^2) > y_{t, \text{flex}}^2 - y_{t, \text{fix}}^2 \]

or
\[ w_{\text{fix}} > w_{\text{flex}} \]

Thus, the parameter \( \psi \) which is solved for should in general corresponds to a lower bound since a lower value, by placing a lesser weight on price stability—precisely what the CFA countries
have enjoyed—would in most cases, as just shown, make $W_{fix}$ larger than $W_{flex}$. See, Devarajan and Rodrik (1991) for a similar approach.

For each country, $\psi$ is the implicit trade off between fluctuations in output and fluctuations in the price level. For the CFA countries, $\psi$ indicates the minimum weight that must have been attributed to price stability if remaining in the CFA Zone was preferred to leaving the zone. Thus, $\psi$ can also be considered as the price paid for maintaining price stability since it corresponds to the percentage amount of output fluctuations it would be willing to forego to reduce fluctuations in the price level by one percent.

As $\psi$ increases, remaining in the zone becomes less and less attractive and adjusting the current account with the nominal exchange rate becomes preferable to adjusting the current account with public investment. In what follows, we provide time series graphs of $\psi$ for several CFA countries.

In order to calculate the country specific implicit lower bound on $\psi$, it is necessary to obtain an estimate of the shocks which were faced by each country. Since the model is concerned with unexpected shocks, we need to estimate the unexpected component of shocks. To do so, we identify the unexpected component of a shock on a variable with the residual from the "best" time series model (i.e one which utilizes all the information up to $t-1$ to predict a variable at time $t$). More
precisely, we have (rational expectation solution)

\[ \text{shock on } y_t = E(y_t | t-1) - \hat{y}_t \]

where \( \hat{y}_t \) is the predicted value from the regression equation

\[ y_t = A(L)y_{t-1} + \epsilon_t \]

and where \( L \) is the lagged operator (defined by \( L(y_t) = y_{t-1} \)), \( A \) is a polynom and \( \epsilon_t \) is white noise.

For the export and the import price, the data consisted from yearly export and import unit values extracted from the African Socioeconomic and Financial Data. For each price, an AR(1) process was estimated. The fit was excellent for all countries with R-squared in the 0.80-0.97 range. (The poorest fit was for the export unit value for Togo for which we had R-squared equal to 0.71). Results are shown in Table 5.3 for the export unit values and in Table 5.4 for the import unit values. The results show that the export and the import unit values follow a random walk\(^3\). Therefore we have

\[ \epsilon_t = \rho_t - \rho \rho_{t-1} \]

\[ \rho \sim 1 \]

as an estimate of our shock variable for the prices.

\[ ^3\text{This result is not surprising, at least for the export price, since commodity price which have become very volatile behave like an asset price.} \]
For the interest rate, we used a six months LIBOR on US $ deposits extracted from the International Financial Statistics.\textsuperscript{4} The fit on an AR(1) process was not very good. However, more complicated lagged structure (for which we lose observations) did not perform better. Thus, we also selected an AR(1) process for the international interest rate on non concessional debt. Results are shown in Table 5.5.

Time series graphs for $\psi$ were done for all CFA countries except for Mali and Equatorial Guinea which joined the zone only in 1984 and except for Chad due to lack of data. For all countries, $\psi$ is consistently high during the period 1971-1987. It is always above 4 and, in most cases, fluctuates around the 5-6 range although occasionally the highest value of $\psi$ attained can be quite large (e.g., approximately 13 for Gabon (1971, 1975), 38 for Niger (1986) and 28 for Senegal (1971). To illustrate the approach, time series graphs of $\psi$ for three countries, Burkina Faso, Gabon and Niger, which are representative of what we obtained, are shown in Figure 5.1.

Furthermore, for the values of the parameters chosen, $\psi$ is much more sensitive to interest rate shocks than to price shocks since the ratio of the interest rate variance coefficients (the one in the numerator and the one in the denominator) is approximately

\footnote{Although non concessional debt has a maturity exceeding six months, this was the international interest rate for which we had more observations. We also ignore differences across countries and across time in interest rate premiums.}
twice the ratio of the import or of the export price variance coefficients. $\psi$ is more stable and less sensitive to the values of the parameters selected for the model if it is computed using only import and export price shocks. In what follows, we limit ourselves to import and export price shocks.

In order to check the validity of ignoring interest rate shocks (or more precisely the square of the shocks), we examine the nature of the shocks which affected the CFA countries. To do so, we defined the shock on a variable $y$ as (i.e., random walk assumption again) $y_t - y_{t-1}$ and then weight the squared values of interest shocks by the ratio of non concessional debt to GDP, the squared values of import price shocks by the ratio of imports to GDP and the squared values of export price shocks by the ratio of exports to GDP. Then, we define a shock variable as the sum of the three shocks and derive the composition of external shocks by computing the three ratios (which naturally sum up to one) of each shock to the shock variable. For all CFA countries, we find that interest rate shocks are much smaller than the two other shocks. To illustrate this, Figure 5.2A shows the composition of shocks for the same three countries used for Figure 5.1.

Naturally, to check the actual composition of the shocks (as opposed to what is needed to calculate $\psi$), one should not compare the magnitude of the squared values of the shocks (since it tends to make large shocks look even larger and small shocks look even
smaller) but the magnitude of the shocks themselves. Computing these and using the same weighting technique as before did not change qualitatively the results. Figure 5.2B illustrates this by showing the magnitude of the shocks for Burkina Faso.

Finally, we recompute $\psi$ ignoring interest rate shocks. Figure 5.3, again for Burkina Faso, Gabon and Niger, shows examples of times series graphs of $\psi$. The results are similar for the other countries. The values of $\psi$ found are now fairly stable and are in the 4-5 range.

The results should, naturally, be interpreted with caution since the value of $\psi$ is sensitive to the parameters selected. However, for the period analyzed, it seems that the cost to the CFA countries of being in the zone, as measured by the value of $\psi$, has been fairly high: To be indifferent between leaving and staying in the zone, the implicit weight used in the objective function had to be around 5 implying a trade off between output and price fluctuations heavily (5 times more) in favor of price stability.

$\psi$ known

We now treat $\psi$ as a fixed parameter and look at the effect of disturbances (taken one at a time since we have assumed all the error terms to be uncorrelated) on the difference
\[ W_{\text{fix}} - W_{\text{flex}} \]

In what follows, we also consider that all parameters, except for those of the money supply equations, are the same for all countries. Since our interest is in the balance of payment adjustment rule used by the CFA countries, we concentrate on the money supply equation which, as stated earlier, embodies all the key behavioral assumptions about the economic structure of the CFA countries. Therefore, for each disturbance, we limit ourselves to discussing the influence of \( \lambda_1 \), \( \lambda_2 \) and \( \psi \).

An economy for which \( \lambda_1 \) is large is one for which fluctuations in the price of imports have a large influence on the current account. This corresponds to countries which can easily substitute domestic goods for imports if \( P^m_t \) increases. These countries are likely to be relatively more industrialized (e.g., the coastal countries of the zone as opposed to the landlocked countries).

An economy for which \( \lambda_2 \) is large is one for which fluctuations in the price of the main export commodity has a large influence on the current account. This corresponds likely to countries which are highly dependent on one commodity export (e.g., oil producers like Congo or Gabon and Côte d'Ivoire with coffee and cocoa\(^5\)) as

\(^5\)In this case, the price of the main export commodity is defined as a weighted sum of the prices of coffee and of cocoa. See, footnote 7 in Chapter 4.
opposed to countries whose export revenues come from more diversified sources (e.g., Senegal with groundnut, phosphate rock, fishing and tourism).

An economy for which \( \nu \) is large is one for which there is a strong link between public investment and the balance of payments. This is true for countries in which the share of investment made by the public sector and its import component are both relatively large. This is more likely to be the case for the lesser industrialized countries of the zone.

As \( \lambda_1 \) increases, \( \Omega \) increases and, for a fixed exchange rate, all the effects of the domestic disturbances, whether on real output or on the price level, decrease. This is also true for the interest rate and the export price disturbances while the converse is true for the import price disturbance. Thus, in the fixed exchange rate regime of the CFA Zone, countries which are less dependent on imports (in the sense that their substitution possibilities are greater) are less affected by disturbances. However, precisely because they will substitute away from imports if \( P^m_t \) increases, import price disturbances have a comparatively larger effect on real output and on the price level.

For a fixed exchange rate, \( \lambda_2 \) does not affect \( \Omega \). As \( \lambda_2 \) increases, the effect of an export price disturbance is greater on both output and the price level and the effect of all other
disturbances is unchanged.

For a fixed exchange rate, as \( v \) increases, both \( \Omega \) and \( \Omega v \) increase. Foreign disturbances have a comparatively smaller effect while the effect of a real demand disturbance is comparatively greater. Results are inconclusive for the other two domestic disturbances. The lower magnitude of the foreign disturbances is precisely what one would expect since fiscal policy (through changes in public investment) is more powerful in mitigating the effect of foreign disturbances. This enhanced effect of fiscal policy can lead countries to drastically decrease investment in the face of adverse external shocks and, as a result, to face what may even be lower growth prospects than if the adjustment to the external shock had been done differently and, in particular, with a nominal depreciation.

Less industrialized countries (in particular the landlocked countries) of the zone which are more likely to have a low \( \lambda_1 \) and a high \( v \) are more affected by a real demand disturbance and less affected by an import price disturbance. For all the other disturbances, due to conflicting effects, the results are inconclusive.

For a flexible exchange rate regime, we have the following results. As \( \lambda_1 \) or \( \lambda_2 \) increase, \( \Omega' \) increases. The effect on output of a real demand, monetary and of an interest rate disturbances
decrease while for an export price disturbance, the effect is weaker when $\lambda_1$ increases but stronger when $\lambda_2$ increases. Thus, the result that comparatively more industrialized countries (which are expected to have a larger $\lambda_1$) are less affected by (most) disturbances still holds. For the price level, an increase in $\lambda_1$ lessens the effect of a monetary and of an export price disturbances while an increase in $\lambda_2$ also lessens the effect of a monetary disturbance but increases the effect of an export price level disturbance. For all the other disturbances, the results are inconclusive. Since fiscal policy is not used as an instrument of balance of payment adjustment, the parameter $\nu$ has no effect on the magnitude of the disturbances (it does not appear in the model).

We now discuss the influence of the money supply parameters on welfare. The approach used is to analyze how the difference

$$W_{\text{fix}} - W_{\text{flex}}$$

varies with the parameters $\lambda_1$, $\lambda_2$ and $\nu$. The purpose of this simulation exercise is to evaluate how the structure of an economy of a typical CFA country (defined by the relative magnitude of the parameters of the money supply equation) affect the desirability of one exchange rate arrangement over the other.

For the simulation below, since the magnitude of the interest shock has been consistently smaller for the CFA countries, we compute the difference
with the export and the import price shocks set at 1 (numeraire) and the interest shock set at 0.1. To be consistent with the previous section, we select a "high" \( \psi \) of 4.

Figure 5.4 shows how the difference in welfare varies with the parameter \( \lambda_1 \). As \( \lambda_1 \) increases from 0.35 to 0.85, the difference in welfare (which is negative, suggesting a preference for a fixed exchange rate regime for that relative magnitude of shocks) increases. This implies that the attractiveness of a fixed exchange rate regime over a flexible one decreases as \( \lambda_1 \) increases. In other words, other things being equal, the more industrialized countries are less likely to benefit from the institutional arrangements of the zone than the less industrialized ones.

Figure 5.5 shows how the difference in welfare varies with the parameter \( \lambda_2 \). As \( \lambda_2 \) increases from 0.5 to 1, the difference in welfare (which is also negative) increases. This implies that the attractiveness of a fixed exchange rate regime over a flexible one decreases as \( \lambda_2 \) increases. In other words, other things being equal, countries which are highly dependent on one source of foreign exchange revenues (i.e., export sector dominated by one commodity) are less likely to benefit from the institutional arrangements of the zone than countries whose export sector is more diversified.
Figure 5.6 shows how the difference in welfare varies with the parameter $v$. As $v$ increases from 0.15 to 0.45, the difference in welfare (which is still negative) steadily increases. This implies that the attractiveness of a fixed exchange rate regime over a flexible one increases as $v$ increases. In other words, other things being equal, the less industrialized countries are more likely to benefit from the institutional arrangements of the zone than the more industrialized ones. This conclusion is consistent with the one reached for the sensitivity analysis on $\lambda_1$.

Thus, we have the following results. Countries which are more likely to benefit from the present institutions are such that one or more of the following applies:

i) fluctuations in the price of imports have a relatively smaller influence on the current account (effect of $\lambda_1$);

ii) fluctuations in the price of exports have a relatively smaller influence on the current account (effect of $\lambda_2$);

iii) there exists a strong link between public investment and the balance of payments (effect of $v$).

Earlier, we have identified these countries with the lesser industrialized ones and the ones with a relatively diversified export sector.

Thus, this would seem to indicate that, other things being
equal, relatively more industrialized countries like Gabon, Congo which are highly dependent on oil are less likely to benefit from the zone. The same may be true for Côte d'Ivoire which is also quite industrialized (by CFA standard) and whose export revenues are essentially from coffee and cocoa (whose export prices are highly positively correlated). Cameroon is also industrialized but has a more diversified source of export revenues (oil, coffee and cocoa). The results also indicate that a country like Senegal which is less industrialized than say Côte d'Ivoire and which has a relatively diversified export sector is more likely to benefit from the institutional arrangement of the zone. Niger, on the other hand, is not very developed but is very dependent on uranium and we cannot conclude. A closer look at the economies of the landlocked countries (Burkina, Central African Republic) and of the coastal countries (Benin, Togo) is necessary before being able to draw any conclusion on the relative magnitude of the money supply equation coefficients.

Interestingly, Devarajan and Rodrik (1991) reach a similar conclusion\(^6\). They conclude that Gabon was probably the most hurt by joining (or remaining in) the CFA Zone and Senegal the least

\(^6\)However, they use a different approach since they do not analyze how differences in the economic structure (as defined by the elasticities introduced in our money supply equation) of CFA countries influence the desirability of one exchange rate arrangement over the other. Rather, they concentrate on implicit output-inflation trade offs which countries should have in order to find the institutional arrangements of the zone attractive. They compute these trade-offs (which are a function of the terms of trade shocks for each country) and find that "Gabon must have a had a particularly low tolerance for inflation vis a vis growth".

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hurt.

Finally, we look at the influence of shocks on welfare. Again, the approach consists of analyzing how the difference

\[ W_{\text{fix}} - W_{\text{flex}} \]

is affected by shocks.

The difference in welfare is a linear function of the squared deviations of each of the shock variable. Thus, if we limit ourselves to the effect of each shock, taken one at a time, all we need to know is the values of the parameters in the difference

\[ W_{\text{fix}} - W_{\text{flex}} \]

For the values of the parameters selected, we have

\[ W_{\text{fix}} - W_{\text{flex}} = -0.1172 \varepsilon_r^2 + 0.0914 \varepsilon_{pm}^2 + 0.0071 \varepsilon_{px}^2 \]

Since the coefficients for the price shocks are positive, we can conclude, at least for the values of the parameters selected, that an increase in the volatility\(^7\) of the export and/or of the import unit values increases the difference in welfare thus making a fixed exchange rate arrangement, other things being equal,

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\(^7\)For a random walk model, an increase in the square of the white noise term is an increase in the square of the difference between the variable at time \(t\) and the variable at time \(t-1\) and thus, corresponds to an increase in the volatility of the variable.
comparatively less attractive. This is consistent with the recent literature reviewed earlier in the paper and with the hypothesis that the CFA institutional arrangements are less appropriate at times of economic instability characterized by a greater volatility in the shock variables. A comparison of the magnitude of the coefficients above also suggest, abstracting from differences in the money supply parameters, that an increase in the volatility of the import unit value is more likely to require an economy to switch to a flexible exchange rate regime than a comparable increase in the volatility of the export unit value.

Finally note that the coefficient of the interest rate shock is negative implying that a fixed exchange rate regime is comparatively more attractive in the presence of increased volatility in the international interest rate. Note also that the difference in welfare is not always strictly positive and thus, that the value of $\psi$ selected is not such that a flexible exchange rate regime is, regardless of the magnitude of the external shocks, always preferred.

5.5 Conclusions

This chapter has developed a model to analyze the CFA countries' balance of payments adjustment strategies when faced with external shocks. The model employed is a Mundell Fleming model with an aggregate supply equation, a wage equation and a
money supply equation which incorporate the fact that the CFA countries cannot use an inflation tax and cannot sterilize changes in foreign reserves. The model is used to solve for output and price fluctuations in the presence of shocks and to evaluate, on the basis of a standard macro welfare function which penalizes output and price fluctuations, how the magnitude and the nature of external shocks influence the desirability of one exchange rate arrangement over the other.

Based on the external shocks faced by the CFA countries, we are able to derive time series for a country specific parameter $\psi$ which corresponds to the minimum relative weight that must be given to price stability in order to make the country indifferent between one exchange rate arrangement or the other. $\psi$ is interpreted as a measure of the cost of staying in the monetary union since it corresponds to the amount of output fluctuations that a country must be willing to forego to reduce fluctuations in the price level by one percent. The results tend to indicate that the cost of membership in the monetary unions must have been fairly high. However, these results should be interpreted with caution since $\psi$ is found to be quite sensitive to the values of the parameters selected and to the presence of interest rate shocks.

The model is also used to analyze how the structure of an economy influences, other things being equal, the relative attractiveness of one exchange rate arrangement over the other.
First, it is shown that the more industrialized countries are less likely to benefit from the institutional arrangements of the zone than the less industrialized ones. This comes from the fact that countries which have a stronger industrialized base have greater substitution possibilities between domestic and foreign goods and are thus likely to have their current account (hence their money supply) be more responsive to fluctuations in the price of imports than less industrialized countries. Second, it is shown that countries whose export revenues come mostly from a single primary commodity are less likely to benefit from the institutional arrangements of the zone than countries whose source of export revenues are more diversified.
### Table 5.1

**Impact Effect on Real Output of Unanticipated Disturbances**  
(Fixed Exchange Rate Regime)

<table>
<thead>
<tr>
<th>Domestic Origin</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Real Demand $u_{1t}$</td>
<td>$\frac{\gamma}{\Omega}$</td>
</tr>
<tr>
<td>Monetary $u_{2t}$</td>
<td>$\frac{\gamma}{\Omega} \left( \delta - \sigma (1-\alpha) - \frac{v'}{v} \right)$</td>
</tr>
<tr>
<td>Supply $u_{3t}$</td>
<td>$1 - \frac{\gamma}{\Omega} (1 + \psi \frac{v'}{v})$</td>
</tr>
</tbody>
</table>

$$\Omega = \gamma \delta + \sigma \alpha + \frac{v'}{v} (\psi \gamma + \lambda_1 + 1 + \psi + (1-\alpha) (\psi - 1))$$

<table>
<thead>
<tr>
<th>Foreign Origin</th>
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</thead>
<tbody>
<tr>
<td>Interest rate $\epsilon_{1t}$</td>
<td>$\frac{\gamma}{\Omega} \frac{v'}{v} \beta$</td>
</tr>
<tr>
<td>Import Price $\epsilon_{2t}$</td>
<td>$\frac{\gamma}{\Omega} \frac{v'}{v} (1-\alpha) (\psi - 1) + \lambda_1$</td>
</tr>
<tr>
<td>Export Price $\epsilon_{3t}$</td>
<td>$\frac{\gamma}{\Omega} \frac{v'}{v} \lambda_2$</td>
</tr>
</tbody>
</table>
Table 5.1'

Impact Effect on Price Level of Unanticipated Disturbances  
(Fixed Exchange Rate Regime)

<table>
<thead>
<tr>
<th>Domestic Origin</th>
</tr>
</thead>
</table>
| Real Demand $u_{1t}$ | $\frac{\alpha}{\Omega}$  
| Monetary $u_{2t}$ | $\frac{\alpha}{\Omega} (\delta-\sigma(1-\alpha)-\frac{v'}{v})$  
| Supply $u_{3t}$ | $-\frac{\alpha}{\Omega} (1+\phi\frac{v'}{v})$  

\[ \Omega = \gamma+\delta+\sigma\alpha+\frac{v'}{v} (\phi\gamma+\lambda_1+1+v+(1-\alpha)(\phi-1)) \]

<table>
<thead>
<tr>
<th>Foreign Origin</th>
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</table>
| Interest rate $\epsilon_{1t}$ | $\frac{\alpha}{\Omega} \frac{v'}{v} \beta$  
| Import Price $\epsilon_{2t}$ | $\frac{\alpha}{\Omega} \frac{v'}{v} ((1-\alpha)(\phi-1)+\lambda_1) + (1-\alpha)$  
| Export Price $\epsilon_{3t}$ | $\frac{\alpha}{\Omega} \frac{v'}{v} \lambda_2$  

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<table>
<thead>
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<th>Domestic Origin</th>
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</thead>
<tbody>
<tr>
<td>Real Demand $u_{1t}$</td>
<td>$\frac{\gamma}{\Omega'}$</td>
</tr>
<tr>
<td>Monetary $u_{2t}$</td>
<td>$\frac{\gamma}{\Omega'} \sigma (1+\alpha)$</td>
</tr>
<tr>
<td>Supply $u_{3t}$</td>
<td>$1+\frac{\gamma}{\Omega'} \left[ (\delta + \sigma \alpha) \phi - 1 \right]$</td>
</tr>
<tr>
<td>$\Omega' = (\lambda_1 + \lambda_2 + (1-\alpha) (\phi - 1) - \beta) (\gamma + \delta + \sigma \alpha) - (\delta + \sigma \alpha) (\phi \gamma + \lambda_1 + 1 + (1-\alpha) (\phi - 1))$</td>
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<table>
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<tr>
<th>Foreign Origin</th>
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</thead>
<tbody>
<tr>
<td>Interest rate $\epsilon_{1t}$</td>
<td>$-\frac{\gamma}{\Omega'} (\beta (\delta + \sigma \alpha) + \sigma)$</td>
</tr>
<tr>
<td>Import Price $\epsilon_{2t}$</td>
<td>$-\frac{\gamma}{\Omega'} (\delta - \sigma (1-\alpha) + (\delta + \sigma \alpha) ((1-\alpha) (\phi - 1) + \lambda_1))$</td>
</tr>
<tr>
<td>Export Price $\epsilon_{3t}$</td>
<td>$-\frac{\gamma}{\Omega'} \lambda_2 (\delta + \sigma \alpha)$</td>
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Table 5.2

Impact Effect on Price Level of Unanticipated Disturbances
(Flexible Exchange Rate Regime)

<table>
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</thead>
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<tr>
<td>Real Demand $u_{1t}$</td>
<td>$\frac{1}{\rho \Omega'} - \frac{1-\alpha}{\delta + \sigma \alpha}$</td>
</tr>
<tr>
<td>Monetary $u_{2t}$</td>
<td>$\frac{1}{\rho \Omega'} \sigma (1+\alpha)$</td>
</tr>
<tr>
<td>Supply $u_{3t}$</td>
<td>$\frac{1-\alpha}{\delta + \sigma \alpha} + \frac{1}{\rho \Omega'} ((\delta + \sigma \alpha) \phi - 1)$</td>
</tr>
</tbody>
</table>

$$\Omega' = (\lambda_1 + \lambda_2 + (1-\alpha) (\phi - 1) - \beta) (\gamma + \delta + \sigma \alpha) - (\delta + \sigma \alpha) (\phi \gamma + \lambda_1 + 1 + (1-\alpha) (\phi - 1))$$

$$\rho = \frac{\delta + \sigma \alpha + \gamma (1-\alpha)}{\delta + \sigma \alpha}$$

<table>
<thead>
<tr>
<th>Foreign Origin</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Interest rate $\epsilon_{1t}$</td>
<td>$\frac{\sigma (1-\alpha)}{\delta + \sigma \alpha} - \frac{1}{\rho \Omega'} (\beta (\delta + \sigma \alpha) + \sigma)$</td>
</tr>
<tr>
<td>Import Price $\epsilon_{2t}$</td>
<td>$(1-\alpha) \left[1 + \frac{\delta - \sigma (1-\alpha)}{\delta + \sigma \alpha}\right]$</td>
</tr>
<tr>
<td></td>
<td>$- \frac{1}{\rho \Omega'} (\delta - \sigma (1-\alpha) + (\delta + \sigma \alpha) ((1-\alpha) (\phi - 1) + \lambda_1))$</td>
</tr>
<tr>
<td>Export Price $\epsilon_{3t}$</td>
<td>$- \frac{1}{\rho \Omega'} \lambda_2 (\delta + \sigma \alpha)$</td>
</tr>
</tbody>
</table>
Table 5.3
Regression Results for an AR(1) Process on the Export Unit Values
22 Observations (1965-1987)

<table>
<thead>
<tr>
<th>Country</th>
<th>Estimated $\rho$</th>
<th>t-statistic</th>
<th>R-squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benin</td>
<td>1.004</td>
<td>26.71</td>
<td>0.80</td>
</tr>
<tr>
<td>Burkina Faso</td>
<td>1.031</td>
<td>34.12</td>
<td>0.83</td>
</tr>
<tr>
<td>Cameroon</td>
<td>1.009</td>
<td>30.87</td>
<td>0.87</td>
</tr>
<tr>
<td>C.A.R.</td>
<td>1.037</td>
<td>38.98</td>
<td>0.91</td>
</tr>
<tr>
<td>Congo</td>
<td>1.004</td>
<td>22.08</td>
<td>0.82</td>
</tr>
<tr>
<td>Gabon</td>
<td>1.013</td>
<td>22.34</td>
<td>0.88</td>
</tr>
<tr>
<td>Côte d'Ivoire</td>
<td>1.024</td>
<td>33.30</td>
<td>0.90</td>
</tr>
<tr>
<td>Niger</td>
<td>1.022</td>
<td>59.79</td>
<td>0.94</td>
</tr>
<tr>
<td>Senegal</td>
<td>1.023</td>
<td>31.59</td>
<td>0.86</td>
</tr>
<tr>
<td>Togo</td>
<td>0.999$^*$</td>
<td>20.39</td>
<td>0.71</td>
</tr>
</tbody>
</table>
Table 5.4
Regression Results for an AR(1) Process on the Import Unit Values
22 Observations (1965-1987)

<table>
<thead>
<tr>
<th>Country</th>
<th>Estimated $\rho$</th>
<th>t-statistic</th>
<th>R-squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benin</td>
<td>1.029</td>
<td>56.28</td>
<td>0.96</td>
</tr>
<tr>
<td>Burkina Faso</td>
<td>1.050</td>
<td>45.20</td>
<td>0.95</td>
</tr>
<tr>
<td>Cameroon</td>
<td>1.064</td>
<td>54.17</td>
<td>0.96</td>
</tr>
<tr>
<td>C.A.R.</td>
<td>1.056</td>
<td>60.68</td>
<td>0.97</td>
</tr>
<tr>
<td>Congo</td>
<td>1.047</td>
<td>62.25</td>
<td>0.97</td>
</tr>
<tr>
<td>Gabon</td>
<td>1.052</td>
<td>68.61</td>
<td>0.97</td>
</tr>
<tr>
<td>Côte d'Ivoire</td>
<td>1.034</td>
<td>51.31</td>
<td>0.96</td>
</tr>
<tr>
<td>Niger</td>
<td>1.046</td>
<td>46.47</td>
<td>0.95</td>
</tr>
<tr>
<td>Senegal</td>
<td>1.041</td>
<td>43.09</td>
<td>0.94</td>
</tr>
<tr>
<td>Togo</td>
<td>1.036</td>
<td>41.27</td>
<td>0.93</td>
</tr>
</tbody>
</table>

Table 5.5
Regression Results for an AR(1) Process on the six-month US $ LIBOR

<table>
<thead>
<tr>
<th></th>
<th>Estimated $\rho$</th>
<th>t-statistic</th>
<th>R-squared</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.976</td>
<td>18.39</td>
<td>0.40</td>
</tr>
</tbody>
</table>

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Figure 5.1
Time Series Graphs of $\psi$

psi BURKINA rational expect

psi GABON rational expect

psi NIGER rational expect
Figure 5.2A
Composition of Shocks (Squared Values)

**GABON**
Composition of shocks

**NIGER**
Composition of shocks

- % X shock
- % M shock
- % l shock
BURKINA
Composition of shocks

Figure 5.2B
Composition of Shocks for Burkina Faso
Composition of shocks

year

% X shock  % M shock  % I shock

1986
Figure 5.3
Time Series Graphs of $\psi$
(without interest shock)

psi BURKINA rational expect

psi GABON rational expect

psi NIGER rational expect
Figure 5.4
Effect of $\lambda_1$ on $W_{fix} - W_{flex}$

Figure 5.5
Effect of $\lambda_2$ on $W_{fix} - W_{flex}$
Figure 5.6
Effect of ν on $w_{fix} - w_{flex}$
CHAPTER 6

CONCLUSION

6.1 Summary

This work has analyzed several fiscal policy issues relevant to primary commodities exporter developing countries with a special emphasis on the Franc Zone countries in Africa.

Chapter 2 has provided a description of the functioning of the Franc Zone and as such served as a background to the rest of the thesis. This chapter has also analyzed the historical origins of today's institutions and identified structural deficiencies in the functioning of these institutions. Thirteen countries, all relying heavily on primary commodities for foreign exchange earnings, are engaged in a monetary union which involves pooling of foreign reserves, a currency whose convertibility is guaranteed by France, and a fixed exchange rate with the French Franc. As such, the Franc Zone countries in Africa constitute an ideal set of countries with which to study fiscal policy in primary commodities countries since the only policy instrument available for adjustment and growth is fiscal policy.

Chapter 3 analyzed the environment in which fiscal policy
decisions must be made in order to understand the factors behind the observed tendency to overspend during and following commodity booms. It has been suggested that three effects, pressure to spend, limited disinvestment or policy reversal and limited indebtedness may explain the lack of consumption smoothing by the fiscal authorities. Estimation of a fiscal policy optimizing model (with the pressure to spend and the limited disinvestment or policy reversal effects expressed as costs and with the limited indebtedness effect expressed as a constraint) has shown evidence of policy reversal costs and of liquidity constraints. However, the existence of a pressure to spend effect is only mildly supported by the data. The estimation approach adopted in the chapter is to test the Euler equation derived from the optimizing model. By testing whether the unconstrained Euler equation is violated, we are able to estimate an average of the Lagrange multipliers for the liquidity constraint. In order to do so, it is necessary to split the data (based on the values of an indicator of the latent wealth variable) into a group of a priori unconstrained observations and a group of a priori constrained observations.

Chapter 4 analyzed whether the observed differences in inflation among the Franc Zone countries in Africa can be explained by differences in fiscal policy responses to fluctuations in the price of the main export commodity. After testing for inflation differentials between the Franc Zone countries, the chapter developed a model of price determination for a typical CFA country.
The model is structuralist in the sense that it incorporates important institutional aspects of the functioning of the Franc Zone. The essence of the model is that behavioral differences in fiscal policy between the CFA countries are reflected in differences in inflation rates between these countries. The model was tested empirically for Côte d'Ivoire. An accompanying simulation exercise showed the inflation cycle experienced by Côte d'Ivoire to be tracked quite well by a model like the one proposed in the chapter.

The principles of the Franc Zone is often a subject of political debates. In particular, in light of the poor growth performance of the CFA countries, the institutional arrangements, in spite of the greater monetary discipline imposed by the unions, are criticized for the impossibility of resorting to nominal depreciation. Chapter 5 developed a model of output determination to make welfare comparisons between fiscal policy and exchange rate policy as current account adjustment mechanisms. It is shown that the relatively more industrialized countries and those whose export sector is less diversified (high dependence one commodity) are a priori less likely to benefit from the institutional arrangements of the zone.

6.2 Contribution of the Thesis

This work improves our understanding of fiscal policy behavior
in primary commodities exporters subject to fluctuations in their export revenues. Furthermore, it highlights the preponderant role played by the government's response to changes in the price of the main export commodity for countries with a fixed exchange rate regime.

The first contribution of the thesis is to identify factors which may explain the observed tendency among primary commodities exporting countries to overspend immediately following a commodity boom and to delay adjustment at the onset of a commodity bust. It is suggested that three effects, pressure to spend, limited disinvestment or policy reversal and limited indebtedness explain the observed lack of consumption smoothing by the fiscal authorities. By estimating the Euler equation of a forward looking optimizing model of government spending, we were able to show evidence, using data from the Franc Zone countries in Africa, of policy reversal costs and of liquidity constraints.

The other contributions of the thesis are more specific to the Franc Zone countries in Africa. A structuralist model of a typical CFA country is derived to explain inflation differentials among Franc Zone countries in Africa and to test that changes in government spending are exclusively driven by changes in the international price of the main export commodity. Estimation results for Côte d'Ivoire confirm our hypothesis and replicate quite well the inflation cycle experienced by that country.
Finally, a model of output and price determination is used to assess the adequateness of the institutional arrangements of the Franc Zone. It is shown that the absence of nominal devaluation as an adjustment strategy is more likely to hurt the relatively more industrialized countries of the zone and those whose export sector is less diversified.

6.3 Suggestions for Further Research

Although the empirical work was done exclusively with data from the Franc Zone countries in Africa, the majority of issues addressed by the thesis are relevant to any primary commodity exporter developing country.

Additional work along the lines of Chapter 3 is suggested. The same techniques could be used to test for the existence of the three effects introduced in the chapter for countries outside the CFA Zone\(^1\). In addition, additional research is needed to understand why these effects exist and what the forces behind them.

The objective of the thesis was not to study in detail the CFA Zone and the empirical work was done with data from the Franc Zone countries mostly because the latter constitute an almost ideal set

\(^1\)However, it will be difficult to have a sufficient number of observations for a single country. Furthermore, merging data sets from several countries is likely to be more problematic since, in the absence of any formal institutional arrangements, it will be harder to justify that the behavioral coefficients are the same across countries.
of countries with which to study fiscal policy in primary commodities exporters. However, a lot of policy issues facing the Franc Zone countries in Africa remain unresolved. In particular, further research on identifying problems in the functioning of the zone (e.g., such as the gaps identified in Chapter 2) and on devising ways to improve the existing institutions is suggested. Finally, the poor growth performance of the CFA countries in the 1980's and the few apparent successes of other Sub Sahara African countries which had access to nominal depreciation suggest that the issue of which type of exchange rate regime is the most appropriate for primary commodities exporters remains unresolved and needs to be analyzed further.
REFERENCES


Devarajan S. and J. de Melo, "Membership in the CFA Zone: Odyssean Journey or Trojan Horse?", paper presented at the conference on African Economic Issues, Nairobi, June 1990.


International Monetary Fund, "International Financial Statistics", various issues.


APPENDIX 1

DERIVATION OF THE FIRST-ORDER CONDITION

The model is repeated here for convenience.

\[
\text{Max } E_t \sum_{s=0}^{\infty} (1+\theta)^{-s} [U(G_{t+s}, K_{t+s}) - C_1 (Y_{t+s} - G_{t+s}) - C_2 (G_{t+s-1} - G_{t+s})]
\]

subject to

\[
K_{t+s} = \gamma G_{t+s} + (1-\delta)K_{t+s-1}
\]

\[
A_{t+s} = (1+r)A_{t+s-1} + Y_{t+s} - G_{t+s}
\]

and to

\[
A_{t+s} \geq -A^*
\]

The value function \( W_t \) satisfies the following recursive equation (Bellman equation)

\[
W_t(A_t, K_t) = \text{Max}_{G_t} \left[ U(G_t, K_t) + (1+\theta)^{-1}E_t(W_{t+1}(A_{t+1}, K_{t+1})) - C_1 (Y_t - G_t) - C_2 (G_{t-1} - G_t) + \lambda_t (A_t + A^*) \right]
\]
The first-order condition is

\[ U'_{G_t}(G_t, K_t) + \gamma U'_{K_t}(G_t, K_t) - \left( \frac{1+\theta}{1+\theta} \right) E_t \left( \frac{\partial W_{t+1}(A_{t+1}, K_{t+1})}{\partial A_{t+1}} \right) \]

\[ + (\frac{\gamma(1-\delta)}{1+\theta}) E_t \left( \frac{\partial W_{t+1}(A_{t+1}, K_{t+1})}{\partial K_{t+1}} \right) \]

\[ + C'_1(Y_t - G_t) + C'_2(G_{t-1} - G_t) = 0 \]

To eliminate the value function from the first-order condition above, we use the envelope theorem from which we obtain

\[ \frac{\partial W_t(A_t, K_t)}{\partial A_t} = -\lambda_t + \frac{1+\theta}{1+\theta} E_t \frac{\partial W_{t+1}(A_{t+1}, K_{t+1})}{\partial A_{t+1}} \]

\[ \frac{\partial W_r(A_t, K_t)}{\partial K_t} = U'_{K_t}(G_t, K_t) + \frac{1-\delta}{1+\theta} E_t \frac{\partial W_{t+1}(A_{t+1}, K_{t+1})}{\partial K_{t+1}} \]

Assuming that \( r \) is equal to \( \theta \), that \( \delta \) is equal to zero and that \( \gamma \) is equal to 1, we can rewrite the first-order condition as

\[ U'_{G_t}(G_t, K_t) - \left( \frac{\partial W_t(A_t, K_t)}{\partial A_t} \right) + \lambda_t \]

\[ + \frac{\partial W_t(A_t, K_t)}{\partial K_t} \]

\[ + C'_1(Y_t - G_t) + C'_2(G_{t-1} - G_t) = 0 \]
The first-order condition at \( t-1 \) is

\[
U'_{G_t-1}(G_{t-1}, K_{t-1}) + U'_{K_t-1}(G_{t-1}, K_{t-1}) - E_{t-1} \left( \frac{\partial W_t(A_t, K_t)}{\partial A_t} \right) \\
+ (\frac{1}{i+1}) E_{t-1} \left( \frac{\partial W_t(A_t, K_t)}{\partial K_t} \right) \\
+ C_1'(Y_{t-1} - G_{t-1}) + C_2'(G_{t-2} - G_{t-1}) = 0
\]

We now impose rational expectations and we have:

\[
\frac{\partial W_t(A_t, K_t)}{\partial A_t} = E_{t-1} \left( \frac{\partial W_t(A_t, K_t)}{\partial A_t} \right) + \epsilon_{1,t}
\]

\[
\frac{\partial W_t(A_t, K_t)}{\partial K_t} = E_{t-1} \left( \frac{\partial W_t(A_t, K_t)}{\partial K_t} \right) + \epsilon_{2,t}
\]

where \( \epsilon_{1,t} \) and \( \epsilon_{2,t} \) are error terms with zero means and uncorrelated with any information available at time \( t-1 \).

Taking the difference between the first-order condition at \( t \) and the first order condition at \( t-1 \) and using the assumption above, we obtain:

This gives:
\[ U'_{G_t}(G_t, K_t) - U'_{G_{t-1}}(G_{t-1}, K_{t-1}) - U'_{K_{t-1}}(G_{t-1}, K_{t-1}) + \frac{r}{1+r} \frac{\partial W_t(A_t, K_t)}{\partial K_t} \]

\[ + \lambda_t + C'_1(Y_t - G_t) - C'_1(Y_{t-1} - G_{t-1}) \]

\[ + C'_2(G_{t-1} - G_t) - C'_2(G_{t-2} - G_{t-1}) \]

\[ - e_{1,t} - \frac{1}{1+r} e_{2,t} \]

\[ \frac{\partial W_t(A_t, K_t)}{\partial K_t} = (\frac{1+r}{r}) \left[ U'_{G_{t-1}}(G_{t-1}, K_{t-1}) - U'_{G_t}(G_t, K_t) + U'_{K_{t-1}}(G_{t-1}, K_{t-1}) \right] \]

\[ - \lambda_t + C'_1(Y_{t-1} - G_{t-1}) - C'_1(Y_t - G_t) \]

\[ - C'_2(G_{t-1} - G_t) + C'_2(G_{t-2} - G_{t-1}) \]

\[ + \frac{1+r}{r} e_{1,t} - \frac{1}{r} e_{2,t} \]

This enables us to obtain an expression for the partial derivative of the value function with respect to wealth

\[ \frac{\partial W_t(A_t, K_t)}{\partial A_t} = U'_{G_{t-1}}(G_{t-1}, K_{t-1}) + U'_{K_{t-1}}(G_{t-1}, K_{t-1}) \]

\[ + (\frac{1}{r}) \left[ U'_{G_{t-1}}(G_{t-1}, K_{t-1}) - U'_{G_t}(G_t, K_t) + U'_{K_{t-1}}(G_{t-1}, K_{t-1}) \right] \]

\[ - \lambda_t + (1+r) C'_1(Y_{t-1} - G_{t-1}) - C'_1(Y_t - G_t) \]

\[ - C'_2(G_{t-1} - G_t) + (1+r) C'_2(G_{t-2} - G_{t-1}) \]

\[ + \frac{1+r}{r} e_{1,t} - \frac{1}{r} e_{2,t} \]
Using the envelope theorem, we finally derive the first-order condition as:

\[
(1+r) \left[ U'_t(G_t, K_t) - U'_{t-1}(G_{t-1}, K_{t-1}) \right] \\
+ U'_c(G_t, K_t) - U'_{c+1}(G_{c+1}, K_{c+1}) \\
+ (1+r) \left[ U'_G(G_t, K_t) - U'_{G_{t-1}}(G_{t-1}, K_{t-1}) \right] \\
+ C'_1(Y_t - G_t) - C'_1(Y_{t+1} - G_{t+1}) \\
+ (1+r) \left( C'_1(Y_t - G_t) - C'_1(Y_{t-1} - G_{t-1}) \right) \\
+ (1+r) \left( -C'_2(G_{t-2} - G_{t-1}) + C'_2(G_{t-1} - G_t) \right) \\
- C'_2(G_t - G_{t+1}) + C'_2(G_{t-1} - G_t) \\
- \lambda_{t+1} - \lambda_t - r\lambda_t \\
+ u_t + u_{t+1}
\]

with

\[ u_t = (1+r)e_{1,t} - e_{2,t} \]

and

\[ u_{t+1} = -e_{1,t+1} + e_{2,t+1} \]